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NATIONAL FIRE PROTECTION ASSOCIATION

Quarterly

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NATIONAL FIRE PROTECTION ASSOCIATION
International

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National Fire
Protection Association
INTERNATIONAL
60 Batterymarch Street,
Boston 10, Mass., U.S.A.

The non-profit, technical and educational membership organization devoted to reduction of loss of life and property by fire. More than 10,000 members.

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QUARTERLY

of the

NATIONAL FIRE PROTECTION ASSOCIATION

Vol. 39 April, 1946 No. 4

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Accounts of fires appearing in the Quarterly are copies of or extracts from reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

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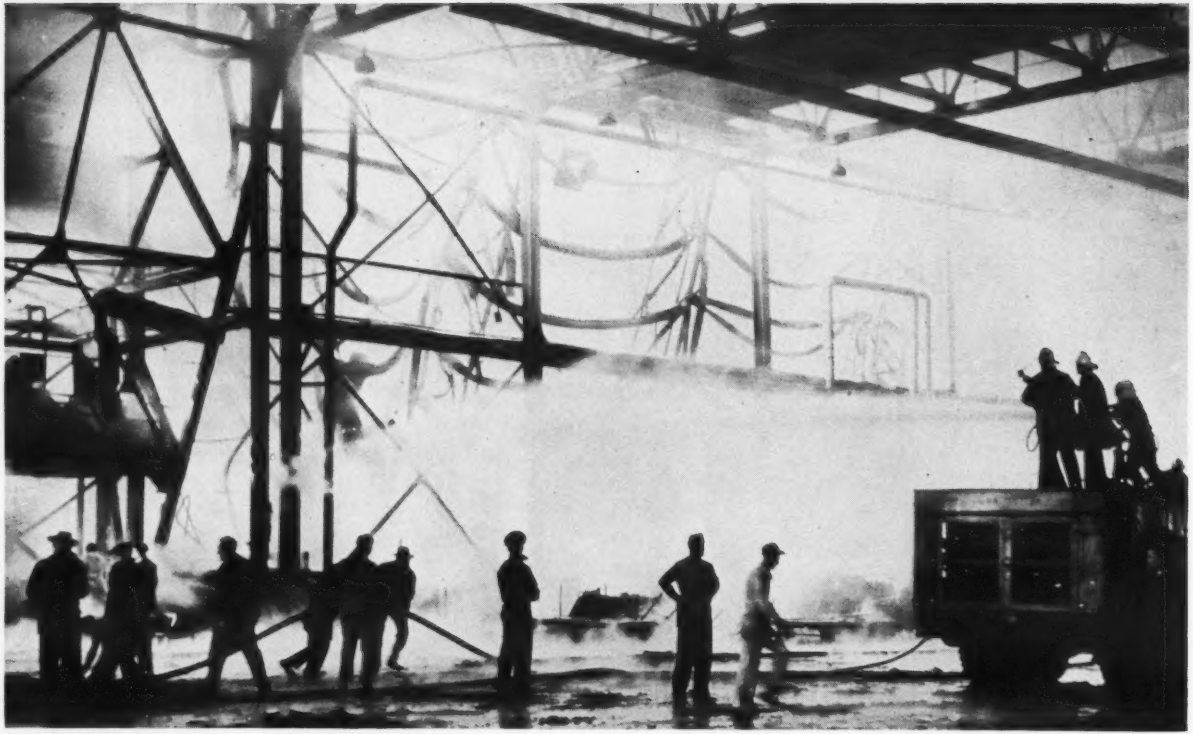


Press Association.

Ten men died when fire swept the 13-acre, undivided AAF Repair Hangar at Tinker Field, near Oklahoma City on January 28. Starting near the fuel booster pump test stand from ignition of gasoline vapors, flames heavily damaged one of four communicating and adjoining unsprinklered hangars (each 90 feet high at arch center) and a large shop area. One B-29 was also heavily damaged. Preliminary estimate of loss is $1,000,000.

The Quarterly

Vol. 39 April, 1946 No. 4

Let's Stop These Big Losses

The United States and Canada are rapidly burning up their economic wealth. We are suffering a disgraceful number of big fires and can ill afford the waste and dislocation from such fires at any time. Such losses certainly should not be tolerated in this period of scarcity. Consumers cannot purchase goods already in short supply and producers lose their product and their customers. Big losses can be stopped through well-recognized principles of fire protection engineering, and there is plenty of money available to provide the right kind of protection. What has been lacking is a persistent unified effort on the part of all those concerned to see that conditions which make for big fires are eliminated.

The record is tragic. Large loss fires for last year reported in the January QUARTERLY were unprecedented in the 50-year history of the N.F.P.A. Fire Record Department. There were 163 large loss fires recorded with an estimated monetary loss in excess of $122,000,000. Thus far, 1946 continues that bad record. Analysis of the big fires of last year and the more than 50 similar big fires already reported for 1946 indicates that a substantial number of them fall in five broad occupancy classifications: — warehouses, multiple occupancy mercantile and manufacturing buildings, metal workers, food processing plants, and mercantile group buildings. The causes of these fires, where determined, are the inevitable usual common hazards of poor housekeeping, careless smoking, poor maintenance of heating, electrical wiring and other equipment. The reasons why the fires in these classes of occupancy became big fires are also relatively obvious. In most cases the fire had gained such headway when discovered that nothing much could be done to control the loss, despite valiant efforts by fire departments. It is a well-established fact that in the absence of automatic sprinklers or automatic fire alarm protection where fire reaches major proportions before any alarm is sounded, no fire department, no matter how efficient, can be expected to prevent a major loss to a large building of combustible construction or occupancy.

We might well ask ourselves why there are so many situations where disastrous big fires can and do occur. It is not difficult to come to the conclusion that in too many cases the owners of such properties have made their decision to provide or not to provide protection for their properties solely on the basis of the fire insurance rate credit involved.

No one will argue against adequate fire insurance coverage as good business policy, and no one will argue against the fairness of rate credits for the installation of fire protective equipment. It is certainly

strange but true that even with obvious and important insurance savings many property owners and managers still will not provide automatic fire alarm or automatic sprinkler protection. In many cases where protection is provided solely because of insurance rate credits, the management often remains indifferent to the importance of automatic protection, and poor maintenance and poor fire prevention procedures follow. The only sure way to halt these disgraceful fire losses is to make property owners and managers realize that destructive fires will inevitably hurt their business. Under present conditions the expense of providing adequate fire detection and extinguishing equipment, or other features, is relatively insignificant as compared with the importance of uninterrupted operation of business. The important thing is to conserve the buildings and products of industry in these days of scarcity.

By and large, the big fires have not occurred and are not occurring in properties of high hazard. A plant making high explosives usually has a good fire record because it has a consciousness of fire danger and has provided the funds and a staff competent to take the necessary steps to provide adequate protection, in many cases much more stringent than measures required by fire insurance carriers. Most of the occupancies that are burning and causing the large losses are those where the fire hazards are much less. Experience has shown that high hazard occupancies can be and are adequately safeguarded, so there certainly is little excuse for ignoring proven methods of protection in the less hazardous occupancies.

What can be done to bring about a correction of this situation? Certainly the obvious step is a concerted drive on the part of all those qualified to advise the public in fire prevention and protection. Such a drive ought to be made right now so that the uneconomic current trend of high fire losses may be halted. Every N.F.P.A. member, every fireman, every salesman of fire protective equipment, every insurance engineer and inspector, and, in fact, every insurance broker, agent and salesman, ought to participate in such a drive. Many of these men valiantly helped during the war, through the States War Inspection Service and other agencies, to stop needless fires affecting vital war supplies. An equally valuable service can be rendered to the whole American public now. It is a service that will be really appreciated if it rolls up sufficient momentum to make a substantial reduction in these losses.

Meeting of Board of Directors.

New York, January 28, 1946.

Present.

George W. Elliott, Chairman
Richard E. Vernor, President
Earl O. Shreve, Vice-President
Hovey T. Freeman, Secretary-Treasurer

A. L. Brown	C. W. Pierce
Russell Grinnell	D. J. Price
W. F. Hickey	H. E. C. Rainey
H. L. Miner	L. G. Schraffenberger
A. J. Mullaney	A. H. S. Stead
H. E. Newell	Lloyd T. Wheeler

Percy Bugbee, General Manager, Robert S. Moulton, Technical Secretary, Horatio Bond, Chief Engineer, Charles S. Morgan, J. K. McElroy and George H. Tryon, Engineers.

Business Transacted.

1. The two new members of the Executive Office staff added since the last meeting of the Board of Directors — Messrs. J. K. McElroy and George H. Tryon — were introduced to the Directors.

2. The Executive Office was directed to prepare and record an appropriate resolution on the untimely death of Board Member Charles C. Hannah.

3. The program of the 1946 annual meeting was discussed and the Program Committee was authorized to proceed in accordance with the general outline presented.

4 (a). Treasurer Freeman's report on the finances of the Association, indicating that the Association's income for the current fiscal year is substantially exceeding budget estimates, was accepted:

(b). The following Executive Office reports were presented and accepted:

Membership.
Publications.
Field Service.
Fire Marshals Section.
Firemen Magazine.

5. Board Member H. E. C. Rainey presented his resignation as a member of the Board, which was accepted with a vote of appreciation of Mr. Rainey's services.

6 (a). General Manager Bugbee reported on gifts to the endowment fund and for research. It was voted to accept these gifts with due appreciation to the donors.

(b). General Manager Bugbee made a brief progress report on the proposed research on fire gases, which was accepted.

7. Secretary-Treasurer Freeman reported that the Finance Committee had given further consideration to a pension plan for the N.F.P.A. staff and requested additional time for the development of a satisfactory pension plan. The report was accepted and the committee requested to present a definite report at the summer meeting of the Board.

8. General Manager Bugbee reported on his investigation of a possible public opinion survey as suggested by the Committee on Long Range Planning. The report was accepted and the matter referred to the Long Range Planning Committee for further consideration, with the suggestion that the Public Relations Committee be consulted.

9. Members of the N.F.P.A. staff made reports on various war activities.

10. The report of the Committee on Technical Committee Procedure, as presented by Chairman C. W. Pierce, was adopted, including action as follows:

Confirmation of the creation of a new Committee on Magnesium, with

the following scope:

> "To obtain and correlate information on fire hazards, methods of storage, handling and use, and fire protection of magnesium and its alloys, and to develop standards for safe storage, handling and manufacture. *Note:* Measures for the prevention or control of magnesium dust explosions are under the jurisdiction of the Committee on Dust Explosion Hazards."

Confirmation of the appointment of a New Committee on Fire Gas Research, with Board Member John L. Wilds as Chairman, to operate with the following scope statement:

> "To direct and interpret research on gases produced in fires."

On request of the Committee on Firemen's Training, changing the word "text" to "source" in their scope statement, the revised statement to read as follows:

> "To promote effective training of firemen in cooperation with other agencies, and develop source material for such training."

11. It was voted to confirm the technical committee appointments appearing in the 1945 Year Book made by the Committee on Technical Committee Procedure, as authorized by the June meeting of the Board, and additional committee appointments as follows:

Automatic Sprinklers.
Gordon Price, South-Eastern Underwriters Assn., replacing George H. Porter.

Aviation.
Walter T. Johnson, American Airlines, Inc.

Electric Railway Car Houses and Cars.
A. F. McDougald, American Transit Assn., replacing E. J. Jones, deceased.
W. G. Piwonka, American Transit Assn., replacing W. O. Randlett.

Explosion Venting.
Alan L. Kling (Chairman), Associated Factory Mutual Fire Insurance Cos., replacing Hylton R. Brown, who remains a member of committee.

Farm Fire Protection.
J. E. Cryan, The Farm Underwriters Assn., replacing Rush Carter.
L. G. Keeney, Farmers Mutual Reinsurance Assn.

Finishing Processes.
R. L. Strong, Associated Factory Mutual Fire Insurance Cos.

Fire Gas Research (New Committee).
John L. Wilds (Chairman), Protection Mutual Fire Insurance Co.
Dr. M. M. Braidech, National Board of Fire Underwriters.
L. W. Hutchins, Safety Research Institute.
Dr. C. M. Peterson, American Medical Assn.
Dr. H. H. Schrenk, U. S. Bureau of Mines.
Alvah Small, Underwriters' Laboratories, Inc.

Fire Pumps.
W. H. Connor, Associated Factory Mutual Fire Insurance Cos., replacing E. W. Cousins.

Flammable Liquids.
H. W. Gwynn, replacing Earl J. Smith as Underwriters' Laboratories' representative.

Gases.
H. W. Gwynn, replacing Earl J. Smith as Underwriters' Laboratories' representative.
N. J. Thompson, Associated Factory Mutual Fire Insurance Cos., replacing G. W. Brahmst.

General Storage.
Walter Paine (Chairman), Aetna Casualty & Surety Co., replacing E. Jay Hogan, who remains a member of committee.
William G. Welch, Furriers Customers Syndicate.
J. D. Lodge, Railroad Insurance Assn.

Hazardous Chemicals and Explosives.
E. A. Blair, Associated Factory Mutual Fire Insurance Cos., replacing E. E. Crandall, deceased.

Magnesium (New Committee).
Hylton R. Brown (Chairman), U. S. Bureau of Mines.
E. W. Fowler (Secretary), National Board of Fire Underwriters.
L. E. Burgess, South-Eastern Underwriters Assn.
W. E. Chessman, Improved Risk Mutuals.
John Hommes, Western Actuarial Bureau.
Alan L. Kling, Associated Factory Mutual Fire Insurance Cos.
A. M. Lennie, Magnesium Association.
S. M. MacCutcheon, National Safety Council.
N. D. Malone, Magnesium Association.
H. E. Muir, Factory Insurance Assn.

John A. Neale, Underwrtiers' Laboratories, Inc.
Benjamin Richards, Underwriters Service Assn.
Fred W. Shepard, International Association of Fire Chiefs.
J. C. Smith, Magnesium Association.
T. H. Wright, Ohio Inspection Bureau.

Museums, Art Objects and Historic Buildings.
Coston C. Crouse, Connecticut Department of Education.
P. M. Farmer, Central Station Fire Protection Assn., replacing Frank M. Cowan.
George Nixon, Marine Office of America.

Ovens and Furnaces.
James B. Smith (Secretary), Associated Factory Mutual Fire Insurance Cos.

Places of Outdoor Assembly.
Wm. E. Russell, National Canvas Goods Manufacturers Assn.

Protection Against Lightning.
C. D. Friday, U. S. Navy Department, replacing W. G. Hill.
J. E. Ritchie, N.F.P.A. Fire Marshals Section, Ontario Fire Marshals' Office, replacing C. W. Caskey.
John M. Thompson, Lightning Rod Manufacturers Assn., replacing B. C. Burkett.

Protection of Openings in Walls and Partitions.
Frank H. Alcott, National Lumber Manufacturers Assn., replacing Frank P. Cartwright.
R. C. Corson, Associated Factory Mutual Fire Insurance Cos.

Special Extinguishing Systems.
J. T. W. Babcock, Factory Insurance Assn., replacing Harry Jordan, deceased.
Ira W. Knight, National Automatic Sprinkler and Fire Control Assn., replacing Henry A. Fiske.

Visual Education.
M. I. Parker, Missouri Inspection Bureau.

12. Mr. C. W. Pierce, Chairman, Committee on Technical Committee Procedure, reported on proposals for the reorganization of the Electrical Committee. After discussion the committee was instructed to present a specific plan for consideration at a later meeting of the Board.

13. The report of the Electrical Committee relative to its activities in preparing a new edition of the National Electrical Code was accepted.

14. The proposed standard on Places of Outdoor Assembly prepared by the committee on this subject under joint sponsorship of the N.F.P.A. and the Building Officials Conference of America (A.S.A. No. Z20) was submitted to the Board for approval. It was voted to instruct the Committee on Places of Outdoor Assembly to reconsider Par. 5-2 (e) of the standard, also the protest of the National Lumber Manufacturers Association, and then submit the standard to letter ballot of the Board.

15. It was voted to adopt the revised text of the pamphlet on Lacquer Manufacturing Plants as printed in the 1945 Proceedings.

16. The report of Chairman Benjamin Richards of the Committee on Finishing Processes relative to the 1945 report of his committee was received.

17. On recommendation of the Committee on Piers and Wharves in its 1945 report, the N.F.P.A. field service was authorized to confer with the U. S. Coast Guard relative to the coordination of local control over pier and wharf construction and protection.

18. The following committee was appointed to pass upon the text of the tenth edition of the Handbook of Fire Protection on behalf of the Association: A. L. Brown, Chairman, Hylton R. Brown, A. L. Cobb, H. A. Fiske, Alvah Small.

Fatal Housing Fires.

The nationwide shortage of housing, the use of substandard buildings for habitational purposes, and the marked tendency of property owners to neglect normal upkeep and maintenance are all factors in the rising toll of loss of life by fire.

On the following pages we present a pictorial review of some of these fires during the first quarter of 1946. They are merely samples of a large number of such tragedies that occur daily throughout the country.

Such fires as these, besides the toll in lives, also aggravate the serious housing situation and add to the inflationary trends which are skyrocketing prices.

Contributing to the fatalities occasioned by such fires is the overcrowding of facilities to the point where exits, normally sufficient for original occupancy, now become totally insufficient. This overcrowding also accounts for poor housekeeping, larger collections of trash and rubbish, and the introduction of increased chances for human carelessness by the mere multiplication of occupants. On these, fire breeds.

While the high rents being secured today decrease the frequency of suspicious fires, property owners are generally not returning their profits into improvements and betterments.

Real estate sharpshooters are indiscriminately selling or leasing anything with a roof. Human beings are today living in buildings which, before the war, were considered obsolete, unsuitable for human occupation, or too far out of repair for economic rehabilitation. Many outmoded structures are being converted into what the owner calls "apartments," but are better described as hovels. Such conversions are particularly dangerous from a fire-safety point of view because of the disregard usually shown to basic fire prevention measures which are automatically engineered in new construction.

Control of the situation can only be accomplished by:

(1). Vigorous fire department inspection of habitational properties.

(2). Enforcement of fire prevention and building codes.

(3). Cooperation among the city departments for effective control over the use of unsafe structures for habitational purposes and limitations on capacity.

(4). A local publicity campaign to alert householders to the urgency of fire prevention, the need for proper maintenance of their property, and the course of action to follow if fire occurs.

International News.

Philadelphia, Pa., Jan. 25, 1946. Two children were burned to death and six other members of the family injured in this fire in a poorly maintained structure in the Race Street section.

Acme Newspictures, Inc.

Kansas City, Mo., Jan. 27, 1946. Eleven persons, including six children, lost their lives in a 5:16 A.M. fire which started in a pantry closet in a first floor apartment and spread through a glass transom to the hallway and up an open stairway to the second and third floors. The three-story masonry and wood building was originally built in the 1890's as a private residence. Three 14-inch vertical fire escapes had been installed, but delayed alarm prevented escape of trapped persons. The fire was believed caused by carelessness in the handling and storage of matches.

Press Association, Inc.

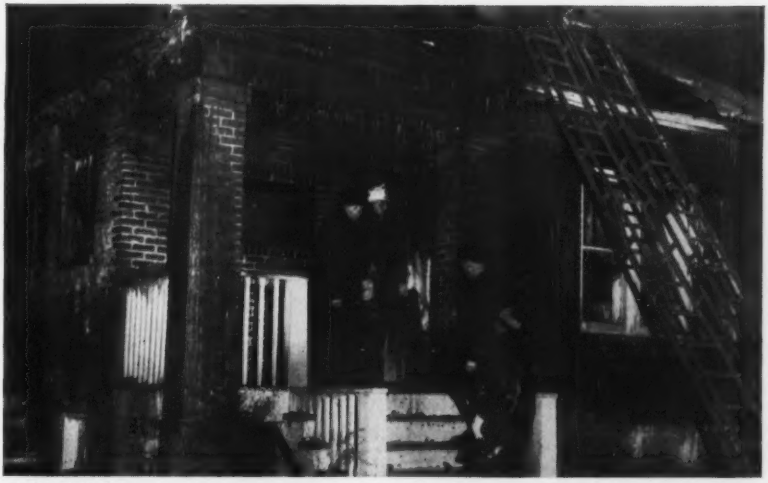
Malden, Mass., March 17, 1946. Five of six members of a family were killed by a fire which swept their one-and-a-half story bungalow at 5:58 A.M. The sole survivor, a boy of ten, tried unsuccessfully to arouse his parents and younger sisters. Cause: home-made wiring in violation of local laws.

International News Photos.

Tallman, N. Y., Feb. 10, 1946. Six elderly women, patients of the Pinehurst Convalescent Home, died as the result of a savage, though brief, fire which originated in a linen closet under the stairs shown in the picture to the left. This stairway was the main means of exit for the occupants, and lack of a stairway enclosure permitted the flames, which burst from the closet, to totally block its use. An investigation, after the fire, revealed no clews as to the cause of the blaze and there was no evidence that the closet contained other than linens. While the heat of the fire was so intense that wax candles in upstairs rooms were totally melted, the exterior (see photo above) was almost untouched. The home had last been inspected for fire hazards three years ago and the tragedy revealed the fact that no law was locally applicable which would have required enclosed stairwells or exterior fire escapes for such an occupancy. County and township authorities are reported to have started immediate action to enact a fire safety code into law.

Gardner Roberts.

Portland, Maine, Jan. 7, 1946. Substandard construction, a midnight fire, and lack of adequate fire exits caused four deaths and eleven injuries in this multiple occupancy mercantile and apartment building. The city building inspector termed the fire a final answer to critics contending that the city building code was too severe.



Chicago Daily News.

Summitt, Ill., Dec. 18, 1945. Four children suffocated in an early morning fire in this dwelling just outside the city limits of Chicago. Gases from the fire, retained by closed windows, caused the deaths even before the fire was reported.

Press Association.

Burning of the Catholic Home for the Aged, Garfield Heights, Ohio, February 2, 1946. Fourteen lives lost.

Premature Death by Fire.

Home for the Aged, Garfield Heights, Ohio.

Fourteen inmates of the Catholic Home for the Aged at Garfield Heights, Ohio, lost their lives when a fire flashed through the building shortly after 2:15 P.M. on February 2, 1946. The origin of the rapidly spreading fire is still the subject of a coroner's jury investigation and its exact cause has not yet been determined.

The structure was an unusual type with one-story, full-basement and an attic without draft stops, 13,200 sq. ft. in area. The first floor (approximately six feet above grade) was reinforced concrete, with laminated plywood panel exterior walls, ceilings, and partitions built above the first floor. Information regarding the grades of plywood used in the structure is not available.

It is reported that the building exit facilities were sufficient for a building of ordinary combustibility of this size, though considering the extremely rapid spread of fire throughout the building and the physical condition of the occupants, they were tragically inadequate. Newspaper accounts state that many of the 62 residents were ill in bed, several were crippled, one man was blind, and that the fire spread so rapidly that many were unable to leave their rooms. Several of the residents in the home perished when they became hysterical and resisted rescue efforts.

It is reported that the fire was preceded by an explosion. It is believed that an accumulation of hot gases in the attic space had passed unnoticed until the explosion occurred.

The Garfield Heights Fire Department responded, and as the building was already badly involved, called for assistance from Cleveland, Cuyahoga Heights, Maple Heights, and Bedford Fire Departments. In addition, physicians and nurses, with Red Cross hospital supplies, were sum-

Press Association.

The building was a one-story structure, with exits which would have been considered ample for a building of ordinary combustibility.

Acme.

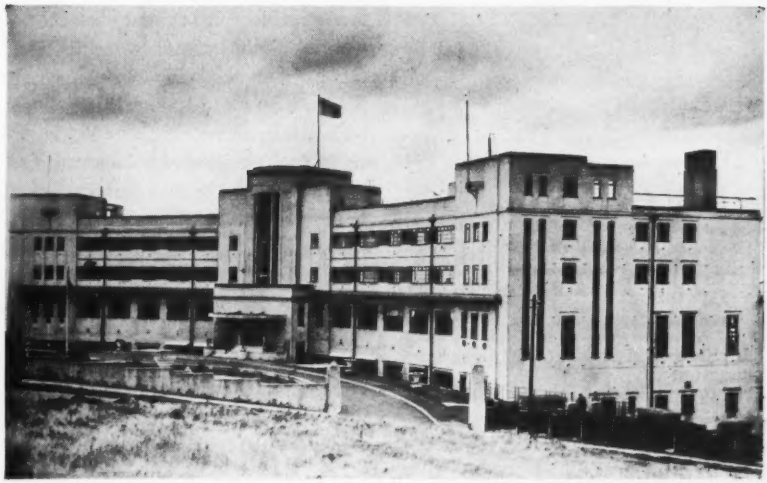
A portion of the ruins. The concrete floor limited the downward spread of fire.

moned to the scene by radio. The extremely rapid spread of fire forced the Garfield Heights Fire Department, upon arrival, to confine its efforts to rescue work. A 22-mile per hour wind and the lack of fire walls or fire doors which would confine the fire to any one part of the building contributed to the rapidity with which the fire spread throughout the structure. Attendants of the home had attempted to fight the fire with pails of water, and when this action failed, an alarm was transmitted to the fire department by telephone.

In all eight engine companies used fourteen hose streams in an effort to extinguish the fire. Their efforts in the face of heavy odds were unavoidably insufficient.

The quick-burning characteristics of the structure above the first floor and the lack of automatic sprinkler protection to offset structural deficiencies, combined with a delayed alarm, are apparently responsible for the loss of life which occurred.

An enclosed stairway to the fire-resistive basement prevented any downward spread of fire and is credited with permitting salvage of various materials from the basement area following the fire, indicating the advantages of fire-resistive construction for this type of occupancy.



British National Fire Service College.

By Assistant Fire Force Commander H. F. Griffiths,
Deputy Commandant, N. F. S. College.

The National Fire Service College opened its doors to its first students within six weeks of the passing of the Act, in August, 1941, which provided for the creation of a National Fire Service in Great Britain. The College was housed in a modern hotel of nearly 500 rooms, high upon a hill near Brighton and about 200 yards from the chalk cliffs of Sussex overlooking the sixty miles of water which separated the college from Dieppe and the Germans. When our American friends arrived they were impressed with the speed with which personnel, training programs and equipment were obtained and developed.

The first Commandant of the College was Brigadier C. C. Hewitt, D.S.O., M.C., who was released by the War Office for this important appointment. Fire Force Commander A. W. A. Paramor, later decorated by the King with the Order of the British Empire, was appointed the Director of Studies. A highly successful partnership resulted. Brigadier Hewitt had a distinguished military career, and his awareness of the importance of esprit-de-corps and tradition, coupled with his wide experience in officer training in both Europe and the United States, was to prove one of the greatest factors in the work of converting nationalization from a paper transaction into an established fact. Commander Paramor brought with him an unsurpassed record of fire fighting and a reputation for a breadth of vision all too uncommon in the parochial world of prewar days.

This article was prepared for the N.F.P.A. QUARTERLY through the cooperation of Sir Aylmer Firebrace, Chief of Fire Staff, National Fire Service, London, England. It describes the activities of the National Fire Service College, Saltdean, Brighton, England; the events which led up to its formation; its work during the war years and the way in which it is now meeting the needs of peacetime.—ED.

Mr. Herbert Morrison (right), the then Home Secretary, watches an experiment in the College laboratory.

Late in 1944, Commander Paramor was posted to an operational command. His place was taken by Fire Force Commander G. Bennison. In July, 1945, as the European War had ended, Brigadier Hewitt resigned, as he felt his task was completed. He will long be remembered by the Fire Service for the monumental work he accomplished during his three years and ten months of office. Fire Force Commander Bennison succeeded to the Commandantship of the College at that time.

As was to be expected, instruction at the College was conducted in a somewhat warlike atmosphere. This was no doubt very proper, but it was nevertheless distracting for students to have their work interrupted by air raid sirens perhaps half a dozen times in twenty-four hours. By day, nuisance raiders regularly crossed this part of the Coast, but, while there was a good deal of shooting both from above and below, the number of bombs dropped in the district was not so great as one might have expected. By night, German planes were regularly overhead, and the white college building was often brightly illuminated by the light of flares and tracers. On one stormy afternoon, a disabled Dornier missed the main building by 50 feet and blew up a short distance away, with its bomb load and crew still on board. On another occasion, arrangements had been made for thirty officer students to take part in an exercise on a block of flats about half a mile along the coast. Owing to bad weather, the exercise was postponed with fortunate results, as at the very time it would have been in progress the flats were straddled with a stick of bombs.

On the day of the Dieppe raid, the district was on a twenty-four-hour air raid alert, and the College was used as an observation post by the Navy. Observers on the main building of the College watched a huge fleet of invasion craft set out for the French coast in the early hours of the morning. In the evening, the craft could be seen coming back again, fewer in number and badly mauled, but still looking very gallant in the light of the setting sun.

Robot bombs presented the College with very special difficulties. The bombs came in from the sea from five different directions and, with the College being directly on the coast, no really satisfactory warning system was possible. It was eventually decided to get on with the instructing and to ignore these clumsy looking pilotless aircraft as they trundled their way across the sky, often a few hundred feet above the ground. Some dozens of them detonated within sight and sound of the College, but apart from broken windows, there was no damage. Even when a hundred tons of ammunition blew up on a lighter close by, the College came through unscathed, but it must be admitted that there were many times when it was difficult for the instructors to compete for the attention of their students with far more interesting events taking place outside the windows.

Throughout the war, the resources of the College were placed at the disposal of

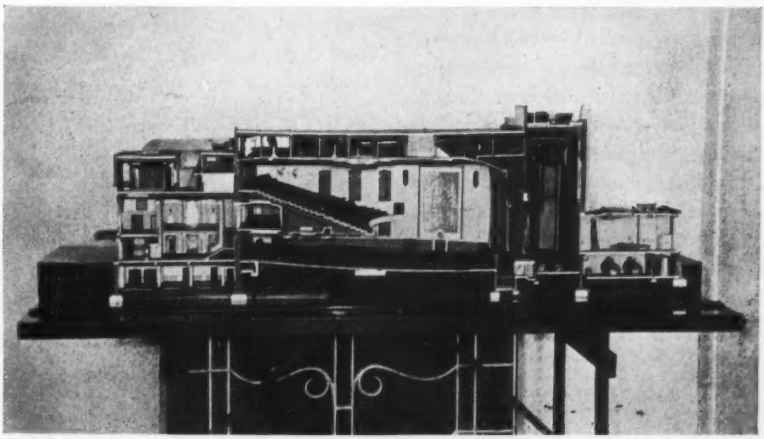
the armed forces of Great Britain and her Allies. Many hundreds of fire officers from the armed forces of a dozen different countries were students at the College. The closest liaison was maintained with the Army Fire Service, the Naval Fire Force and the Royal Air Force Fire Wing, and the constant interchange of problems and ideas was profitable to all concerned. A short course was arranged for fire officers in the U. S. Army awaiting return to the United States.

The College has always been something more than an establishmment for dispensing instruction; it is a place where fire officers and other interested persons from all over the world are always welcome to meet and to exchange freely experiences and views. Almost any day of the year, one can count on meeting interesting people in the spacious anteroom—a group of visiting scientists from Stockholm, the engineer of a large water undertaking, Senior Officers of the Sapeurs Pompier from France or a Fire Officer from Sierra Leone. Many well-known figures from North America have been entertained by the Commandant from time to time—Chief Engineer Horatio Bond of the N.F.P.A., George L. Swan, National Board of Fire Underwriters, W. J. Scott, K. C., Ontario Fire Marshal, and J. K. McElroy, Economic Warfare Division, U. S. Embassy—to mention only a few.

The N. F. S. College Is Established.

Prior to 1938, the provision of fire-fighting facilities in Great Britain was largely left to the conscience and good will of approximately 1500 Local Authorities (Municipalities). Outside the large cities there was no legal obligation to provide fire brigades for the protection of either the persons or the properties of their rate-payers (taxpayers). In some parts of Great Britain efficient brigades operated; in others, the brigades were either less efficient or non-existent.

In July, 1938, the Fire Brigades Bill, which placed upon every Local Authority the duty to provide and maintain an efficient Fire Brigade, passed into law. The



W. J. Scott.

Among many cutaway models used for instruction, this theatre model is unusually accurate in detail.

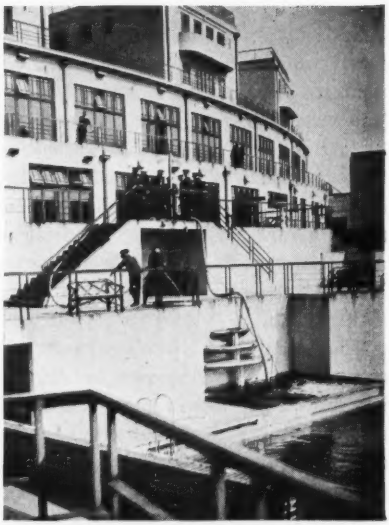
Act included a number of sections calculated to assist the Local Authorities in the execution of their new duties. Among these was Section 6, which read, "The Secretary of State may establish a Training Center for Courses of Instruction for members of Fire Brigades at the expense of the Government." This was the first promise of a central fire college.

War was imminent, and in the months that followed July, 1938, the Local Authorities were busy recruiting a huge Auxiliary Fire Service. With the outbreak of war in September, 1939, an appeal went out to members of the Auxiliary Fire Service to undertake whole-time duties. These men were enthusiasts who had done their training in their own time. Response to the appeal ran into six figures, and the fire-fighting manpower of the country was increased tenfold in a night. From that time onwards, there were few days or nights without enemy aircraft over some part of Great Britain.

In August, 1941, Royal assent was given to an Act of Parliament which united the Auxiliary Fire Service and the regular Fire Brigades of Britain into a single National Fire Service controlled by the Home Office. This meant the country wide standardization of such important items as ranks, conditions of service, equipment, drills, discipline, communications and fire-fighting techniques. No one thought that this could be achieved by the issue of printed circulars. It was realized that personal contact with the officers of the service was the only way to achieve the high standard of efficiency and uniformity demanded by the urgent considerations of war.

Training Courses.

Prior to January, 1942, only male students of junior officer rank had been accepted for training. In that month Mrs.



A deep lift pump test in progress, using the swimming pool at the College for water supply. All parts of the nine buildings on the site are used for instruction.

Nest Stoneham was appointed Supervisor of Women's Studies, and courses for women officers were soon in full swing. Women in the Service were responsible for such duties as administrative work, control room work, catering and driving. Technical training was given under these headings, but emphasis was very much on subjects calculated to develop officer qualities. At the end of 1944, it was decided to close the Women's Wing. It was agreed by all that the innovation of co-education in the Fire Service had been a very great success. Mrs. Stoneham was made a Member of the Order of the British Empire for her distinguished services.

Later in 1942, the first Senior Officers Training Course was inaugurated for officers of Divisional Officer rank with commands of upwards of 1000 men and 250 women. Long hours were devoted to problems of organization and administration.

There were many short courses designed to meet the specific requirements of specialist officers. For example, each Regional, Fire Force and Divisional Headquarters in the National Fire Service had a water officer, responsible in his command for provision of an adequate supply of static water for use during air raids. Every water officer in the country attended a technical course at Saltdean, dealing with hydraulics, the erection and disposition of static water tanks and problems associated with relaying water over great distances. A special technique for relaying water was developed at the College while these courses were in progress, and the practical results were most gratifying. On one occasion water officers had a 350-gallon (British gallon) per minute relay operating over a course ¾ mile long in rather less than eighteen minutes. Conditions were far from ideal, for the route included a hill 150 ft. high, blackout conditions were maintained and with the thermometer standing at 4° below zero, the roads were covered with ice. This was but one of many answers which were provided to those few die-hards, who insisted on regarding the College as an academic establishment.

Every command in the country had its own training school where Firemen, Leading Firemen and Section Leaders periodically took refresher courses. The staffs of these schools received their training at the National College. A special one-month course was prepared and nearly 1000 junior officers were passed through it. The syllabus (course of study) was designed, not to teach the technicalities of fire fighting, but to improve the ability of the student to instruct others. Students were taught how to take a drill, how to conduct a discussion, how to correct faults and how to arrange exercises. It was generally agreed that the standard of instruction in the command training schools improved appreciably as these courses progressed.

The College reached a milestone in its career when, in 1943, it received for the first time the Chief Regional Fire Officers and Fire Force Commanders. These men, the top senior officers of the Service, were brought together in small conference groups for a week, with a few lectures on technical subjects and much discussion on topical problems. The experiment was a great success, and the senior officers from England, Ireland, Scotland, and Wales now regularly meet around the conference table at the College.

Methods of Instruction.

The task of selecting and training suitable staff instructors for the College is one that never ends. A new instructor takes from six to eighteen months to reach full efficiency. Officer instructors have been returned to operations after not more than three and one-half years in residence. On arrival at the College, new men are trained in general duties and then allocated four or five individual references, such as hydraulics or mechanics, on each of which the new instructor is expected to become an expert. Considerable practical experience on the subjects given is valuable, but considerable work is necessary for new men before they can hope to reach the standard necessary to enable them to instruct. The new instructor's progress is greatly helped by having at his disposal the finest fire library in the country, and unlimited travel to any part of Great Britain is possible to secure fresh experience or information which may be needed.

The problem of discovering the most effective instruction methods has been

The tactical table, a practical training aid, is effectively used to test students in solving fire control problems encountered under simulated air raid conditions. As the instructor develops the problem, student officers place miniature fire pumps, hose, and other equipment to meet situations of water supply failure, road blocks, etc. Concealed lights in the buildings, instructor controlled, lend a realistic touch.

subject to constant research. Many methods have been tried out and later developed or rejected, according to experimental results. It has been established beyond all doubt that lectures are the least efficient and least popular method with students, who remember and understand better something they have seen, done or have thought out for themselves. All too often the student forgets something he has been told. After years of experiment, this is now the principle upon which all instruction in the College is based. A visitor moving round the College might not break in on a single lecture, but he would certainly see training films, demonstrations, exercises and discussions. These are the instructing media which can be relied upon to produce tangible and enduring results. If the subject is a practical one, the objects under discussion will, if possible, be in evidence and will be used by the students. If this is not possible, as in the case of ship fire fighting, the students will be gathered around a model ship and will carry out exercises upon it with the aid of model appliances. If the subject is the theory of hydraulics, the student will, guided by the instructor, arrive at the solutions himself and then go outside to check his accuracy in practice.

Great importance is attached to the instructional value of exercises. Models are often used for this purpose, but many full-scale exercises are also staged, particularly in connection with special services or rescue. In one such exercise students effect a rescue of persons trapped by collapsed scaffolding. In another, it is necessary for breathing apparatus to be worn by the students to enable them to rescue two "engineers" overcome by an escape of ammonia gas in a duct, actually flooded with ammonia. From the trainees' point of view, there is a great psychological difference between wearing breathing apparatus in fresh air and wearing it in a suffocating atmosphere. The "victims" are always members of the instructional staff and respond appropriately to expert or inexpert handling. With their skillfully simulated injuries, they have sometimes been mistaken for genuine casualties by passers-by.

Training Aids.

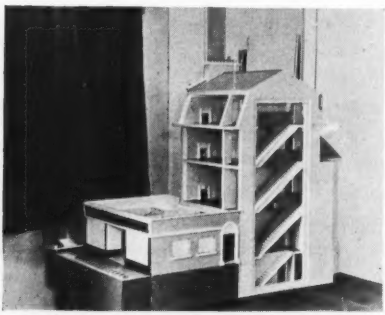
Many readers will appreciate the administrative and physical difficulties that had to be surmounted in the preparation of training aid material. The problem was not made easier by the fact that the demand for the various types of courses changed from month to month, and the importance of individual subjects waxed and waned with the developing war situation.

When the enemy was making an all-out attempt to destroy British oil storages, the subject of oil fire fighting was of primary importance and the instruction consisted of laboratory demonstrations, test fires in small oil tanks, outdoor exercises using major air-foam apparatus, indoor exercises on models and the showing of films taken at some of the larger oil storage fires. On several occasions, the technique developed at the College for controlling large oil fires was successfully applied by past students to fires started by enemy bombing. At another stage in the war, when ammunition was flowing through our ports in vast quantities and when ammunition dumps in the south of England were only a rifle shot apart, great importance was given to the subject of explosives. The students were instructed in the best methods of stowing ammunition on board ship and of storing it in large dumps on land. With the confidence that comes of knowledge, the handling of fires involving explosives was greatly improved,

situations of water supply failure, road blocks, etc. Concealed lights in the buildings, instructor controlled, lend a realistic touch.

and many possible disasters were checked in their very early stages.

By late 1942, the College was working to capacity, with up to 250 students in residence and up to nine different courses running simultaneously. Instruction was given on 100 different subjects, each requiring its own specialist instructor, technical equipment and literature.



W. J. Scott.

Cutaway model of a store and dwelling.

On the operational side, a great deal of time was spent around the tactical table. This was a model of an imaginary, high risk, built-up area and was used as the basis for large scale exercises. The exercises were always in the charge of a highly competent instructor, who would describe the progress of a raid, and the student was taught to deploy his model appliances to cope with rapidly changing situations. These exercises were extremely realistic through use of concealed lights in the model buildings and the student was greatly helped by the fact that the instructor could produce simple or complicated fire situations on the table by pressing a few switches.

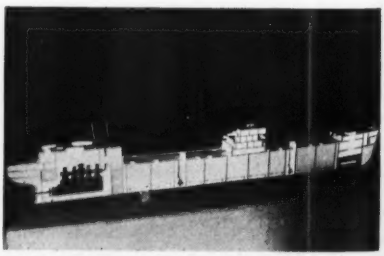
A number of classrooms are occupied with detailed models of warehouses, shops, roofs, ships, etc. Many of the models are used for exercises, while others are examined during sessions on building construction.

There are rooms fitted with sprinklers, drenchers (open sprinklers), and other extinguishing equipment. These rooms are of concrete and metal construction, with transparent panels in the walls through which students can observe the progress of fire and the sprinkler heads operating.

The hose room contains specimens of all known examples of hose, and a wide variety of specimens illustrating the various types of damage, such as cuts, abrasions, rubber acid, and mildew. There is on hand all the equipment necessary for effecting repairs, and experts are available to demonstrate approved methods. The College has developed and introduced a number of new methods for dealing with damaged lengths of rubber-lined hose.

Breathing apparatus rooms contain a wide variety of modern British, American, French and German sets as well as compressors for recharging oxygen and air cylinders. The theoretical side of the subject is dealt with, but of the thirty hours devoted to breathing apparatus in junior courses the majority of the time is spent in carrying out exercises in heat and smoke. These exercises are most strenuous and are generally considered more exacting than anything likely to be encountered on the fire ground.

The laboratory, in charge of a chemist,

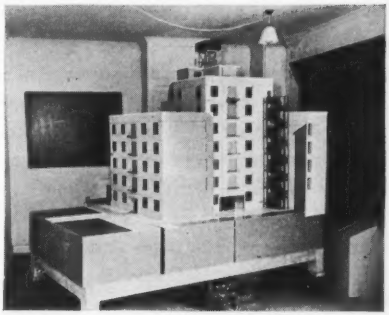


Sectional model of an oil tanker used for instructional purposes in the ship fire-fighting courses.

has become one of the most important parts of the College. Much time is spent on such subjects as physics, organic and inorganic chemistry, industrial fires, flammable and toxic liquids and the chemistry of fire. The student sees for himself an explosion of sulphur dust; the extent to which water will dissolve ammonia; the comparative values of carbon tetrachloride, methyl bromide, carbon dioxide, foam and water as fire extinguishing media; just what can happen when alcohols are stored in close proximity to oxidizing agents; how water mains become encrusted in certain districts; the results of allowing water to enter heat treating salt baths, etc. The number of chemical demonstrations which can be given at the present time runs into several hundred, and new ones are developed weekly.

Many readers in the United States will know of the Research and Experiments Department of the Home Office in London. This department is staffed with scientists and is concerned with the development of new equipment and new techniques. One of the most important functions of the Fire College is to act as the link between this department and the operational fire officers in the field. College instruction is constantly being reinforced by a flow of technical information from the scientists. In return, it has passed to the scientists the ideas and problems daily learned from its students.

The library deserves special mention. Only a few years ago it consisted of a shelf full of pamphlets, and now occupies a room of 2000 square feet, with many thousands of volumes, technical and otherwise. Many useful contributions have been received from time to time from friends in many parts of the world, notably from the United States. When instruction classes are not in progress many of the students



W. J. Scott.

Model of a warehouse and factory used for instruction.

are to be found searching for technical works to assist them in their studies or perhaps selecting some lighter weekend reading. About forty new items are added to the library each week. It is interesting to note that in addition to books the library carries a huge collection of photographs, slides, diagrams, plans, maps, periodicals and films dealing with every aspect of fire fighting. The majority of the works in the library are printed in English, but a substantial section of books printed in foreign languages has been developed for the use of foreign visitors.

The museum becomes more comprehensive each day and is now preparing a War Section. Among many other exhibits in this section will be English and German photographs of some of the more spectacular fire raids on Great Britain. It will be greatly appreciated if readers who happen to have photographs taken in Europe will lend the negatives to the Curator.

The Postwar N. F. S. College.

The change-over from war to peace has been going on for over ten months and is now complete. Many subjects which were of primary importance right up to the moment when the last ammunition ships were despatched to the Far East have now

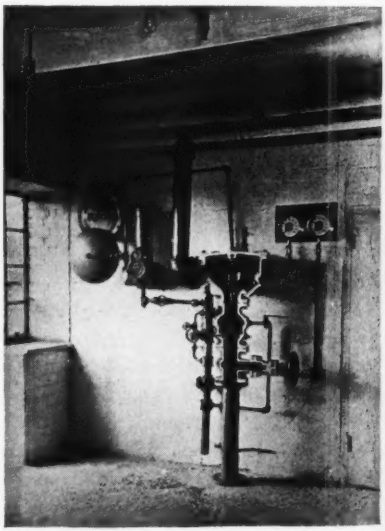
passed out of the curriculum altogether. Many other subjects which were not considered so urgently important as to find a place in the much condensed wartime courses have been introduced into peacetime curriculum. Courses which during the war had to be hurried through in a few weeks have now been expanded to as many months and are the better for it.

At this time there are several courses in progress, namely, an Instructors' Course, a Water Course, a six months' Fire Protection Course, a one-month Reinstatement Course, a Station Officers' Course and a Breathing Apparatus Conference.

The object of the Instructors' Course is to impart to some hundreds of junior officers the various instruction techniques which they will employ in training recruits. The release of National Fire Service personnel is now imminent, but the vigorous steps being taken to recruit from the demobilized armed forces should avert a manpower shortage. Recruits will undergo a two months' course of training at local schools and will be instructed by men now being trained at the College.

During the war, Great Britain was on the receiving end of every sort of modern warlike missile—short of the atomic bomb—and it is not surprising that there is now an acute dearth of houses. Many hundreds of sizable home building schemes are in hand, each entailing the laying of new water mains. The Fire Service is now being consulted about new water mains plans before they are implemented. It will be appreciated that the work of examining these schemes and making recommendations for improvements calls for highly specialized knowledge. The Fire Service officers who undertake this work are each spending two weeks at the College on the Water Course, which has been specially designed to meet their needs. The syllabus provides them with a refresher on hydraulics and a working knowledge of the law relating to the conservation and distribution of water.

The Fire Protection Course, or the Fire Prevention Course, as it might be called in the United States, lasts for nearly six months. The course of study includes chemistry, physics, electricity, fire protection legislation, industrial hazards, fixed fire-fighting installations, building construction, writing of reports, preparation of plans, and many kindred subjects. As part of the course a number of visits are made to various parts of the country having high fire risks and several full-scale fire surveys are completed towards the end of the instruction period. Students successfully completing the course are posted to fire forces where their function is to furnish the technical advice needed by Local



W. J. Scott.

Students study cutaway sprinkler valves, then watch practical demonstrations of extinguishment.

Authorities and other bodies responsible for enforcing fire protection legislation.

During the war, all courses provided by the College were given during residence at the College. In the fall the decision was made that officers nominated for the Fire Protection Course, which commenced in January, 1946, must have passed a three-months correspondence course in mathematics, introduced as a result of the discovery that the mathematical knowledge of many wartime students was insufficient to enable them to take full advantage of the technical courses offered at the College. How far the practice of preparatory correspondence courses will develop remains to be seen, but the idea appears to have merit.

The Reinstatement Course is designed to meet the needs of those returning members of the National Fire Service who held officer rank in the Fire Service before being called up for the Armed Forces. The course is calculated to bring the students up to date and to refresh their technical knowledge.

The Breathing Apparatus Conference is being attended by representatives of all fire forces in the country as well as scientists from the Research and Experiments Department. Its agenda includes operational problems, design of apparatus, and training programs in the use of the apparatus.

The Station Officers' Course is probably the most important course which takes place in the College. It lasts for two months and is attended, as the name suggests, exclusively by officers in charge of stations. The syllabus is too extensive to quote here, but it is enough to say that it covers every aspect of a station officer's day-to-day work, such as administration, fire fighting, discipline, the maintenance of appliances, and the training of personnel. Many hundreds of station officers have already qualified on this course, and it is proposed to continue until every station officer in Great Britain has attended.

During the war the Fire Service, large as it was, was sorely tried and often extended. The raids have now passed into history. No ground organization can prevent air raids from causing damage, but it can be claimed that, but for the efforts of the Fire Service, fires which would have engulfed streets destroyed only the building in which they started, and that where only a street was lost a district might well have been obliterated. The fire fighters had cause to be reasonably satisfied with their work during the early years of the war, but the organization behind them was essentially one designed for peace, and the difficulties encountered were many. Until the establishment of the N.F.S. College, firemen in Great Britain had only known correspondence courses and drill schools.

The postwar fate of the National Fire Service is still to be decided. It has not yet been announced whether it will continue on a national basis, whether it will be broken down into the hundreds of individual units which were originally merged to create it, or whether it will take on some new form. It is singularly fortunate that the work of the College need not be disturbed, as the Fire Brigades Act of 1938, mentioned in the early part of this article, ensures that whatever sort of service emerges from the war period the College will go on.

There is no reason why the steady progress which has been maintained during the last four years should not continue, but it should be understood by all who come here, whether as visitors or students, that it is not and never hopes to be a technical institute. Enough has been said to make it clear that a great deal of technical

instruction is given. However, this is all incidental to the main object of seeing that the Fire Service is efficiently officered. Almost every subject is presented in a way which will develop in the student the leadership, man-management, and administrative qualities which will stand him in such good stead in his operational command. If the object of the College was to produce technicians, its existence would be difficult to justify, for such work could be better and more swiftly done by the very excellent technical schools that are maintained even by the smaller Local Authorities. If, however, it can be said that the 11,000 students handled up to date are now more competent officers for their work at Saltdean, then the Service can be proud of its College—where men work for the future but do not forget the past.

Radio in Fire Departments.

Radio communication offers great possibilities for increasing the effectiveness of fire department operation, as an addition to municipal fire alarm systems and other established means of communication. However, there is no present suggestion that radio should replace other means of communication. The use of radio by fire departments has lagged behind its use by police departments, largely because of the lack of sufficient radio channels for all essential uses. Technical improvements in radio, however, have now increased the number of available channels, and great impetus was given to fire department radio use by the action of the Federal Communications Commission in 1945 in allocating 39 clear channels in the radio spectrum for use by the fire service. The present tentative allocations are as follows:

15 Channels in the 30 to 40 megacycle band

12 Channels in the 104 to 108 megacycle band

12 Channels in the 152 to 162 megacycle band

The latter 24 channels to have a band width of 60 kc. Channels in the 940 to 960 megacycle band will also be used for low power, fixed, point to point station, control circuits, fixed fac-simile circuits, etc.

It should be noted that the number of fire departments which may use radio is by no means limited to the number of channels allocated, as it is possible for cities in different parts of the country to use the same channels.

The action of the Federal Communications Commission now places the fire service on an equal basis with the other emergency services in the operation and use of its own radio communications service. It is also important to mention the fact that allocations have been made to other municipal services, such as highway departments, power and utilities, forestry and conservation, aeronautical (airports), and railroads. These must, of necessity, be coordinated with the communications systems of the fire service if the fire service is to maintain any semblance of efficiency.

NOTE: This article is based upon information furnished by Herbert A. Friede, Superintendent of Fire Alarms of the District of Columbia, who on behalf of the International Municipal Signal Association played a leading part in securing the allocation of fire department channels by the FCC, and upon a bulletin by the International City Managers Association, and data compiled by Warren Y. Kimball of the N.F.P.A. staff.—Ed.

Radio dispatch desk for Station WEY, Boston Fire Department, located in Fire Alarm Headquarters. Two-way contact is maintained with all chief officers' cars, fireboats and rescue squad trucks by high frequency FM operation. Mobile sets respond on a different frequency from headquarters. All fire alarm signals are struck over WEY, simultaneously with their transmission of alarm circuits to the fire stations.

Existing Use of Radio.

Up to March, 1945, the fire departments of seven cities had been licensed to operate radio facilities: Boston, Detroit, New Haven, New Orleans, New York, Portland (Maine), and Seattle. Three of these cities, Boston, Detroit, and New York, together with San Francisco, have used two-way radio systems in connection with the operation of fire boats for a number of years. Fire boats scheduled to respond to certain of waterfront boxes start immediately on receipt of an alarm. The boat may be recalled by radio, however, if the first officer arriving at the waterfront fire notifies headquarters that the boat is not needed. The recall of the boat may save needless operation of drawbridges and interruption of rail and street traffic where response would involve passage up a river or canal.

For many years prior to 1945 the FCC had specified that the emergency needs of fire departments could be met through cooperation with the radio service of police departments, and the fire departments in more than half of the cities with populations over 25,000 have used the police radio (except in seven cities), broadcasting fire alarms on receiving sets installed in the cars of the chief fire officers. Ninety-eight of the 410 cities with populations over 25,000 have put radio equipment on one or more pieces of fire apparatus, according to the Municipal Year Book, 1945, published by the International City

Managers Association. Of these cities, 42 use two-way radio, 37 use one-way, and 19 cities use both one-way and two-way radio.

Comparison with Police Radio.

No city would think of returning to the old days when it was necessary to maintain a large police reserve riot squad in the various precinct station houses to handle emergencies. Yet this is the form of operation still maintained in almost all fire departments where the men are kept inactive in quarters, awaiting box alarms in their section of the city. The fire department, except for a few chief officers' cars, once the major apparatus is out of quarters, is largely out of touch with headquarters until it arrives at the fire alarm box location and reestablishes communication either through a fire alarm box signaling station or through a near-by telephone, or possibly through the radio in a chief's or police car. With the police, when an emergency develops it is possible for the central station dispatcher to route cars to the various sections of the city as needed to cover any situation. Fire departments, particularly in the larger cities, should have separate allocations for radio, and should not expect to depend upon police radio broadcasting facilities.

Apparatus to be Equipped.

To make most effective use of radio, each major piece of fire apparatus and the cars of chief officers should be equipped with two-way radio facilities. Radio communication will enable headquarters to keep in touch with apparatus while it is on the way answering an alarm, thus making it possible for headquarters to recall apparatus if it is not needed, or to make reassignments. The radio would enable headquarters to keep in touch with companies which may be out of quarters attending grass or brush fires, or with companies doing inspection work, thus making them available for responding to alarms the same as if they were at the fire station.

Control of Apparatus.

Where a number of companies respond to a box, the last due companies may have runs several miles long, frequently through severe weather conditions. If these companies were equipped with radio, the first arriving company or chief could turn back the last due equipment if not needed. Such radio facilities would greatly reduce the need of moving companies from station to station in the event of multiple alarm signals in order to cover vacated sections of the city. Under typical operations a considerable number of companies transferred to replace companies responding to alarms may be as long as ten to twenty minutes out of reach of headquarters. Each company could still be largely available for handling fires in its district if radio communication were maintained with headquarters.

Frequently additional alarms are received which would change the covering requirements while numerous companies are still en route. These companies must still continue to the spots designated on their assignment card in order to reestablish communication with headquarters and then report to their destination. With two-way radio these companies could be rerouted as fast as additional alarms are received. The extensive use of radio will not eliminate the fire alarm box as the initial source of alarm, but it will vastly speed up the giving of calls for additional assistance, and in addition the use of radio makes it possible to give more detailed information to headquarters than is possible over the ordinary fire alarm telegraph circuit where code is used. In Bos-

ton, for example, there are recorders on the radio receivers at headquarters that make a record of orders sent in from the radios in the cars of the various fire chiefs.

Release of Men for Inspection Work.

One of the most important reasons for putting radio on every major piece of fire apparatus is to make it possible to utilize all fire companies on a regularly scheduled inspection service which might well eliminate perhaps 50 per cent of all fire calls in the average city. Fire hazards that are now frequently overlooked because the average fire company cannot spare more than an occasional man for district inspection work could be readily eliminated if each fire company spent two full days or more each week in systematic block-by-block inspection of its district. This would be entirely feasible if each fire company were equipped with two-way radio, perhaps supplemented by walkie-talkie radios. Nearly every fire department divides the city into inspection districts with a district assigned to each company. This district is usually considerably smaller than the area in which responses to fires are made, because it is normal to have four to eight companies respond to each alarm of fire sounded over a fire alarm box. By giving each inspection district an alphabetical designation, A-B-C in rotation, it could be arranged so that one-third of the fire companies in a city are out of quarters conducting systematic inspections on each week day, leaving two-thirds of the companies in each district in quarters to respond immediately to first alarms of fires.

In this way, instead of having only one or two of its personnel engaged in fire prevention routine at such times as they can be spared from the chronically undermanned fire companies, a fire company would systematically cover its district under its own officers and employ its full manpower, with the exception of the driver, who would stay with the apparatus to receive alarms. If an alarm were received in the first alarm district of a company out on inspection service, the driver would merely sound the siren on the truck and the men would reassemble from the adjacent buildings and would respond with a delay of only a few seconds. Thus the six-man fire company would have one man on the truck and five men conducting inspection work. If a city had fifteen fire companies, this would mean that one-third of the companies, or five companies, would be on inspection work daily, regardless of weather, unless the weather was unduly severe, when, upon the chief officer's discretion, inspection work would be temporarily suspended. With five companies a day doing inspection work, a city of perhaps 100,000 population would have twenty-five department inspectors out from the companies each day, whereas at the present time they may have only a mere handful of men on occasional inspection work.

Companies on inspection work could take their regular apparatus along and leave the driver with the apparatus so as to maintain radio communication and to prevent tampering with the equipment.

A Typical Example.

Among the cities which have made effective use of the radio are Austin, Texas, and Fort Collins, Colorado. Prior to the beginning of World War II, Austin was able to reduce the actual time of fire companies out-of-service by 37 per cent, using the police radio system with broadcasts to fire officials made direct from the fire alarm office, which is connected by means of telephone wires to the police

broadcasting station. The system is so interlocked that neither department may interfere with the other except during very abnormal conditions. The radio is used in informing police patrol cars the location of fires so that they may direct traffic. Immediately upon arrival at the scene of a fire all companies that are not needed are immediately reported back in service by the commanding officer and are available for alarms in their district, as though they were back in their own station. Fort Collins uses the two-way radio to enable a small force to send out 50 per cent of its strength on inspection work and yet maintain full manpower for fire-fighting details.

The Walkie-Talkie.

Another interesting possibility is the use of walkie-talkie sets designed for the use of the firemen. This will make it possible for the chief or officer to establish a communications point on the fire grounds from which he can coordinate the operations of the entire department.

Improved Working Conditions.

As the fire service is converted to an active fire prevention agency with the finest fire fighting equipment always available, the nature of the job will change and firemen should receive much better recognition and more favorable conditions of employment. In the first place they will have a chance to meet the public and impress the public with the importance of this service. It might, however, be agreed that in the event of unusual situations and multiple alarms a certain part of the off-duty men would be called back to man reserve apparatus. Of course, at night when it is recognized that the life hazard is the greatest, no company would be out on inspection work, and the entire night shift, therefore, would be in quarters available for instant response. However, the use of one-third of the day force for inspection work might achieve such revolutionary results that it would be possible to increase the inspection detail to perhaps 50 per cent of the active companies in the daytime, as reduced daytime assignments are permitted by the National Board of Fire Underwriters grading schedule. New York City, Chicago, and other cities have already successfully employed the idea of reduced daytime responses, but as yet these companies are retained in the stations as reserves rather than employed for fire prevention activities.

The radio promises to be an important aid in the further evolution of fire departments, which are gradually assuming leadership in all phases of fire-safety instead of being interested only in fire extinguishment.

Calcium Chloride Treatment of Coal.

Like other large industries, The Dow Chemical Company plant in Midland, Michigan, has been confronted with various hazards in the storage of its coal. The company found that these hazards made for greater expense and considerable danger, when coal was stored without adequate provision to safeguard it against spontaneous heating, freezing, dustiness and wind loss. Consequently, the company, which daily uses as much as two thousand tons of coal, made a series of tests of various treatments, designed to eliminate many of the objections that have been listed against coal.

Most of the Midland plant's coal is mined in the eastern states and sent to Toledo, Ohio, by train. From there it is loaded into coal carrying ships, freighted across Lake Erie, through Lake St. Clair and Lake Huron, across Saginaw Bay, and unloaded at the storage dock in Bay City. After that it is shipped to Midland by rail —a distance of about 20 miles. The huge storage piles at the Bay City dock were subject to the three principal hazards that affect fine industrial coals most, spontaneous heating, freezing and wind loss.

Calcium chloride has long been used to protect water from freezing — even down to –59° F. Since the freezing of coal is due to the presence of excess moisture, some coal operators have been treating it at the mine, employing the dry flakes or calcium chloride solution to prevent freezing. Furthermore, calcium chloride's ability to form a moisture film was well known, and in trapping the fine coal dust and adhering it to larger lumps, both dustiness and excessive wind loss were eliminated. A study made by the Company showed unmistakably that calcium chloride-treated coal was more resistant to spontaneous heating than untreated coal, and plans were begun to treat all of Dow's coal as soon as it reached the Bay City loading dock.

While either the dry flake or solution method of calcium chloride application is acceptable, it was found that the solution method proved especially desirable where a large tonnage was moved and treated in a short period of time. Spray heads, connected with necessary pipe lines, pumps and tanks, were built and fixed at the end of the boat's conveyor boom. They were set to form a wall of calcium chloride spray, through which the coal tumbles as it drops off the end of the conveyor. Self-unloading ship cargoes of coal, varying from 5000 to 11,000 tons, have been treated very satisfactorily at the Bay City dock with from .75 gallon to 2.5 gallons of a

Mechanical unloading of a coal carrier. Calcium chloride solution is applied to the coal by spray nozzles in the box at the end of the boom.

This article has been abstracted from the Dow Diamond, published by the Dow Chemical Co., and technical data furnished by the company.—Ed.

Two tank cars hold enough calcium chloride solution to treat 10,000 tons of coal.

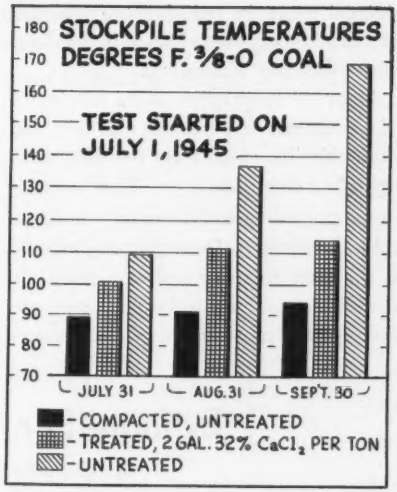
32% calcium chloride solution per ton of coal conveyed at the rate of 28 tons per minute.

Spontaneous heating of bituminous coal by oxidation may result in disastrous fires deep in the coal pile. Cold weather does not hinder spontaneous heating, since coal is an effective insulant and is not chilled deep into the pile. Generally, two methods have been employed to combat the dangers of spontaneous combustion in storing industrial coal. First, storing under water and second, compacting by tractors and rollers. Since recovering coal from water may be expensive and difficult in northern states because of freezing, and since compaction is costly because it requires extensive working with heavy equipment, the company made a study of the resistance of calcium chloride treated coal to spontaneous heating.

Spray nozzles used to apply calcium chloride solution to the stream of moving coal. Twenty-eight tons treated per minute.

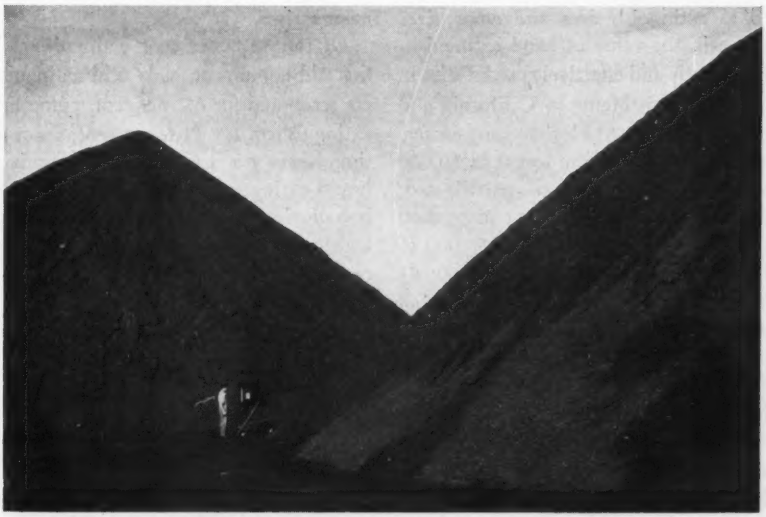
The study was made with two piles of fine coal of approximately 13,500 tons each as conveyed from self-unloading boats. The No. 1 pile was untreated, the No. 2 pile was treated at the rate of two gallons of 32% calcium chloride solution per ton. Four thermometers were buried in each pile in approximately the same position, and were connected to a recording resistance thermometer. During the first 100 days after the test was started on July 1, 1945, the untreated pile reached a temperature of 177° F., while the calcium chloride-treated pile reached a maximum 114° F. in 95 days, after which the temperature started to decline. The original treated pile showed no trouble up to April 1, 1946. The untreated pile had to be removed after 86 days due to a fire which

had developed inside the pile. These tests were made with Pocahontas slack, 3/8 to 0 in., a typical coal subject to spontaneous heating. In the absence of test data on other types of coal, no positive statement can be made as to the effect of calcium chloride on other coals, but the present tests lead to the definite conclusion that the type of Pocahontas coal tested may be stored in large loose piles without danger of spontaneous ignition if properly treated with calcium chloride.



Dust.

An extensive study of wind loss was made over a period of many months, and it was shown that approximately 2% of Dow's total tonnage was lost to the wind every year. Thus, for a corporation using 800,000 tons of coal annually, that loss alone could account for 16,000 tons of coal. Studies made after calcium chloride had been applied to the coal showed that wind loss, for all accountable purposes, had been eliminated. While these studies were made from the point of view of preventing loss of coal, it is evident that elimination of dust may have an important in-



The two 13,500-ton storage piles used in the spontaneous heating test. The pile at the left is untreated, that at the right had calcium chloride treatment. Temperature recording apparatus between the two piles.

cidental effect in reducing the potential fire and dust explosion hazard in buildings where dust may accumulate.

Many mine operators and a few industrial consumers are treating coal with calcium chloride which traps the dust particles with a film of moisture. Dust nuisance in the unloading and handling of calcium chloride treated coal was definitely reduced at the Dow company and as a result absenteeism among the unloading crews was sharply reduced, since the men themselves explained that they don't suffer from the traditional "lungs full of dust" any more.

Prevention of Freezing.

One of the most important results of the use of calcium chloride, from the point of view of monetary saving, is the avoidance of delay and difficulty in the handling of hard frozen coal during cold weather. This phase of the subject is, however, outside the immediate field of fire protection interest and the test data are accordingly not presented here.

Extinguisher Performance.

By Safety Research Institute.
(Member N.F.P.A.)

A survey, made by Safety Research Institute, of records for one year supplied by the fire departments of 191 cities in the United States, reveals some interesting figures regarding the types of equipment used to extinguish fires and emphasizes once again the value of hand extinguishers, promptly and effectively used. Cities in 39 states—from Maine to California and from Washington to Florida—and in five size classifications—from less than 10,000 to over 100,000 population—participated, with nine of the cities having more than 100,000 population; 16 having 50,000 to 100,000; 35 having 25,000 to 50,000; 63 having 10,000 to 25,000; and 68 having less than 10,000 population.

A total of 41,657 fires was recorded by the fire chiefs of the 191 participating cities. Of these fires, 13,624, or 32.7 per cent, were extinguished with first aid equipment and 67.2 per cent were extinguished with heavy equipment. That fire departments used hand extinguishers on almost one-third of the fires is impressive proof of the esteem in which professional fire fighters hold first aid equipment and of their confidence in its ability to deal successfully even with fires that have been burning for several minutes, as is ordinarily the case by the time the fire department arrives.

Of the 32.7 per cent extinguished by first aid equipment, soda acid extinguishers accounted for 6.2 per cent, pump tank extinguishers for 11.6 per cent, foam extinguishers for 1.6 per cent, vaporizing liquid extinguishers for 2.2 per cent, carbon dioxide extinguishers for 1.0 per cent, and miscellaneous equipment for 10.1 per cent.

A breakdown of results according to population of the cities shows the following record for hand extinguishers:

Population	Per Cent Extinguished
Over 100,000	32.2
50,000-100,000	27.9
25,000-50,000	29.9
10,000-25,000	37.6
Under 10,000	34.7

Extinguishers found most favor, and

Equipment Used in Extinguishing Fires.

As reported by 191 Fire Chiefs for a One-Year Period (1942).

How 41,657 Fires Were Extinguished by Fire Departments.

	No. of Fires	Per Cent
WITH HOSE EQUIPMENT		
Hydrant or Pumper Hose Lines, 2½ in.	6,795	16.3
1½ in.	2,397	5.8
Booster or "Jiffy" Hose Lines, 1 in. or ¾ in.	18,376	44.1
Chemical Lines	413	0.9
Standpipe Hose Lines, 1½, 1¼ or 1⅛ in.	52	0.1
Subtotal	28,033	67.2
WITH FIRST AID EQUIPMENT		
Pump Tank	4,820	11.6
Soda Acid Extinguishers	2,577	6.2
Foam Extinguishers	704	1.6
Vaporizing Liquid (Carbon Tetrachloride)	895	2.2
Carbon Dioxide	441	1.0
Miscellaneous and Unidentified Equipment	4,187	10.1
Subtotal	13,624	32.7
Grand Total of All Reports	41,657	100.0

How 3,140 Fires Were Extinguished Before Arrival of Fire Department.

	No. of Fires	Per Cent
Hose Lines	783	24.9
Automatic Sprinkler Systems	197	6.2
Soda Acid Extinguishers	287	9.1
Foam Extinguishers	84	2.7
Vaporizing Liquid (Carbon Tetrachloride)	56	1.7
Carbon Dioxide Extinguishers	6	0.1
Unidentified Extinguishers	126	4.0
Miscellaneous and Unidentified Equipment	1,601	50.9
Total	3,140	100.0

consequently had an opportunity to make the most impressive showing in the Missouri Valley, the Great Lakes and the Eastern states, where fire departments put out with first aid equipment 48.9 per cent; 43.3 per cent and 34.3 per cent, respectively, of all fires.

The survey also furnished evidence that it is not only professional fire fighters who make effective use of hand extinguishers. Of 3140 fires extinguished *before* the arrival of the fire department, extinguishers in the hands of non-professionals did the job on 17.6 per cent.

Newspaper Reports.

Fires extinguished promptly by the use of extinguishers are seldom covered by reports by fire protection engineering agencies, but newspaper reports present interesting evidence of the value of fire extinguishers for immediate emergency use. The results of a survey of reports covering instances of the "successful use" of extinguishers during the period 1942-1945 are shown on page 300. By "successful use" is meant an instance in which the fire is completely extinguished by hand equipment or is kept in check until the fire department arrives, thus averting a serious blaze.

The incidents are classified according to occupancy, and the percentage of the total incidents in each occupancy is recorded in Column I. In Column II a distinction is made on the basis of the individual using

Successful Use of Fire Extinguishers Reported in Newspapers, 1942-1945.

Occupancy	I % of Total	II % of Fires in Each Occupancy Extinguished by: A	B*
Cars, Buses and Trucks	27.2	59	39
Dwellings	12.9	44	51
Industry	8.0	83	11
Stores	7.2	60	30
Garages and Service Stations	5.4	68	32
Office Buildings	4.3	70	30
Theatres	4.3	85	15
Schools	3.9	94	6
Hospitals	2.4	100	0
Hotels	2.4	63	27
Churches	1.7	83	17
Miscellaneous	20.3		

*In some cases A and B do not equal 100%. This is because some reports do not specify by whom the extinguisher was used. These instances would therefore not appear under either A or B, although they are included in the total in Column I.

the extinguisher as follows:

A. Fires extinguished by the occupant, driver, employee or neighbor; that is, by someone who uses an extinguisher which is on the premises and immediately available.

B. Fires extinguished by firemen or police, who bring an extinguisher not previously available, and are professionally trained.

Results by Occupancy.

It can be seen from the table that by far the largest number of "successful use" instances occurred in cars, buses and trucks. If we include fires in garages and service stations, which usually involve cars and are often started by them, the total is 33% of the entire number of incidents. This figure is explained in part by the fact that buses and trucks are usually required to carry hand extinguishers so that they are more likely to be immediately available than they are in homes, for example. Moreover, fires in cars on the highway are likely to enlist aid from passing vehicles. In fact, a characteristic of this type of fire is the frequency with which a passing truck or bus, required by law to carry an extinguisher for its own protection, stops to give aid to a burning car which is not so well equipped.

It is interesting to note that the second largest incidence of successful use of hand extinguishers occurs in dwellings. A large part of the credit for this goes to fire departments which are increasingly stressing the use of hand equipment wherever possible, in order to minimize secondary fire damage.

The fact that the percentage for the use of extinguishers in industry is relatively small may perhaps be explained by the unlikelihood of such incidents reaching the newspapers. A small plant fire, which is extinguished by the plant fire brigade with little damage, is not usually reported by the press, and, therefore, would not affect the figures in this survey.

"Amateur" vs. "Professional" Use of Extinguishers.

The fact that the percentage in Column II-A is greater than in Column II-B in every case but one is interesting. It indicates that extinguishers already on the

premises, used promptly by someone in the vicinity at the time of the fire, were more frequently successful than those later brought in by firemen or police. Or, to put it differently, in most cases where it was necessary to wait for the fire department, by the time such aid arrived the fire had usually gone beyond the point where the capacity of a hand extinguisher was adequate.

The one exception to the generally larger percentages in Column II-A is in the case of dwellings. Fire extinguishers are rarely provided in the home at the present time, as compared with their use in industry and public places. It is not surprising, therefore, to find that a relatively small proportion of home fires is put out by equipment already on the premises.

Excerpts from Newspaper Reports.

In the course of the survey, it was noted that every type of individual, including women and teen-age children, was represented among those who successfully used hand extinguishers. A few examples* can serve to illustrate this point:

In a New York theatre, fire caused by a short circuit enveloped the stage. "Crackling flames and dense, acrid smoke drove 400 spluttering spectators from the theatre... About a dozen youths remained behind to help stage hands man fire extinguishers and other emergency equipment. By the time the firemen arrived, the blaze was under control."

In another theatre, in Ohio: "Smoke from a fire on the balcony rivaled that on the screen ... When firemen arrived they found the blaze had been put out by Hobard O...., electrician, Miss Leona D——, usher, and Miss Gloria L——, office worker, all using hand extinguishers."

One of the numerous instances of successful use of extinguishers in cars occurred when alcohol in an automobile radiator spilled out over the motor. The car was driven by Mrs. B——, and when "she saw smoke pouring from the car she grabbed a fire extinguisher in her car and extinguished the blaze before firemen arrived."

From the table, it can be seen that a great proportion of the hotel fires extinguished by hand equipment involved the use of extinguishers available on the premises. Usually, the equipment was handled by employees. The following instance is typical:

In a large New Haven hotel, "fire was traced to some wiring in the ceiling of the quarters above the ballroom. An unidentified housemaid discovered the fire, sent in the alarm... Pending the arrival of the firemen, she used a chemical extinguisher to conquer the fire."

Store fires were frequently put out by the proprietors, as in the following case in Yorkville, Illinois. The kerosene stove in the H—— Brothers store ignited. "The quick work of the H—— wives and fire extinguishers soon put out the flames."

In some instances neighbors were instrumental in saving homes and stores. In a New York village, which had no public fire apparatus, a fire broke out in the local store. "Residents of the village, using fire extinguishers on hand in the store and others brought from the near-by village school, squelched the flames before they had spread to any extent."

Also noteworthy are instances where students were effective in putting out school fires. In Topeka, Kansas, for example, "fire broke out in the cold air shaft of a school. Leonard B——, 13, snatched up a fire extinguisher and began fighting the fire... It was completely out before firemen arrived."

Because hand extinguishers in the home are the exception rather than the rule, the following two instances are of special interest:

In Ellinwood, Kansas, a housewife started a fire by using gasoline to clean oil-soaked clothing. "The bucket blazed like a blowtorch. Keith R——, Jr., obtained a fire extinguisher from across the street which he played on the flames until the fire department's bigger extinguishers arrived."

And in a town in Massachusetts, there was "a small blaze in the cellar, which was discovered by a son, Billy G——, who sounded the fire alarm box and then proceeded to extinguish the blaze with a hand extinguisher just prior to the arrival of the firemen..."

The recent Hartford tragedy, which has been attributed to panic on the part of a nurse who evidently had had insufficient training in the use of fire extinguishers, points up by contrast the survey figures on hospital fires. These show that fires in hospitals are most frequently put

*Quotations are taken from newspaper reports.

out by extinguishers on the premises. The following instances are cited to show how often hospital employees, armed with extinguishers, have been the means of avoiding similar disasters:

A patient in a hospital in Ohio ignited her dress and, "her clothing afire, ran into the hall, screaming. Taking her back to the ward, the nurse put her on a bed and rolled blankets about her. Another nurse used a small fire extinguisher to smother the flames."

In a Pennsylvania hospital, a student nurse observed smoke coming from a student's room. "The curtains were ablaze. She immediately secured a fire extinguisher and entered the smoke-filled room. A soldier in the waiting room also hurried to the scene and assisted the nurse. There was little commotion and patients knew nothing of the incident."

And in a New York hospital, a fire occurred in an oxygen tent being used by a patient who was critically ill. "A Negro ward maid seized a hand extinguisher and put out the fire in the bed," probably saving the patient's life.

In a number of other reports, as in the last one above, the extinguishers were credited not merely with the prevention of serious fires, but also with the saving of lives, as in the following instances:

In Colorado, an automobile crashed on an icy road and the car burst into flames. Some of the occupants were killed and others were injured. "By the use of a fire extinguisher, they (police officers) were able to keep down the flames until the five occupants of the car could be removed. . . Officers stated that if they had arrived with the extinguisher a few minutes later the two injured but still alive children would have perished in the flaming car."

In Michigan, the gas tank of a snow plow exploded in the county highway garage. A worker's clothes took fire; he "ran around the garage and it took some time for fellow workers to overtake him and put out his blazing clothes with fire extinguishers."

In a chemical plant in New Jersey, three workers were enveloped in flames when a mixture of nitrate and cellulose caught fire. "Fellow workmen extinguished the blaze with fire extinguishers."

Types of Extinguishers Used.

In many cases it was possible to verify the newspaper reports by correspondence and to determine the type of extinguisher involved. Although every type of approved extinguisher was represented in the survey, the soda acid and vaporizing liquid types were those most frequently mentioned.

Extinguishers on Trucks.

In a survey designed to ascertain the usefulness of fire extinguishers carried on motor trucks, the Safety Research Institute, with the cooperation of the American Trucking Associations, Inc., has determined the incidence of control over fires in a test group of 35 truck fleets which in 1943 operated 2718 vehicles a total of 119,057,974 road miles.

A questionnaire was prepared which included suggestions by federal agencies and others interested and sent to a selected group of approximately 500 motor carriers. Replies were received from 27 States, Hawaii and the District of Columbia. The incidence of fire reported by the operators who replied is not large, but the responses upon which the report was tabulated represent such a broad cross section of motor carriers, geographically, as well as in the size and distribution of their fleets, that it is believed the statistical report is representative of the industry as a whole.

It is interesting to note in this connection that the average loss per truck fire is in close parallel with statistical studies made by the Section of Safety, Bureau of Motor Carriers, Interstate Commerce Commission — which is added evidence of the correctness of this sample study.

It will be noted that the greatest losses from fire occurred in connection with accidents in which the driver was injured or where other circumstances prevented the successful use of fire extinguishers. In

most instances where the extinguisher was used the fire was either completely extinguished, or was controlled until other aid arrived. Another factor of value to truck operators is the good will gained from private motorists who have had their own property saved from fire loss by the prompt action of a truck driver with an extinguisher.

Of the approximately 500 carriers queried, 90 fleet representatives, or 18 per cent, supplied information; and of those 90, 68 (75.6%), reported no fire experiences, while 22 (24.4%), reported that they had had a total of 87 fires.

It is reasonable to believe that more fire experiences were encountered than this summary can report, for not all fleets were able to supply complete fire eperience data. Four operators, for example, stated that they had kept no record of fire experiences not involving their own fleets or cargoes, which means that the assistance their drivers gave to others was not included. Many maintain no records of fires in which the cost of refilling the extinguisher is the only cost involved, which of course eliminates from the records many incipient fires readily controlled by extinguishers.

Of the 87 fires reported (suffered by 22 fleets), 35 involved fires coupled with another accident to the unit or its cargo, while 24 involved fire only; the remaining 28 fires did not involve the fleet owner's property.

The record of the fire extinguishers on these 87 fires shows that (a)—45 (51.7%) were put out with the extinguishers carried on fleet units, (b)—12 (13.8%) were controlled with extinguishers carried by the fleets, (c)—22 (25.3%) found the fire extinguishers ineffective, and (d)—8 (9.2%) were not fought with extinguishers. A further breakdown of these figures shows that:

(a)—Of the 45 fires which were extinguished, 28 involved fleet units or cargo and 17 involved only the property of other owners.

(b)—Of the 12 which were controlled, 8 involved fleet units or cargo and 4 involved property of other owners.

(c)—Of the 22 fires on which extinguishers proved ineffective, 7 concerned only property of other owners and, in several instances, the fire had started before the fleet driver arrived on the scene; 8 involved fire coupled with another accident (the driver was not on the scene when the fire broke out in 6 of these fires, and in the other 2, collision conditions were such that life-saving was made the first consideration); in 3 fires the extinguishers were not large enough; in 3 no comment was made, and in 1 the use of the extinguisher was ineffective "due to lateness in use, inexperience on part of the operator, or extinguisher being empty or partially filled."

(d)—Of the 8 fires which were not fought with extinguishers, the driver was injured in 5; and in the other 3 flames enveloped the vehicles before extinguisher could be reached. Some of the comments stated:

"Head-on collision caused gas to ignite; fire too sudden and hot on right side of cab for driver to reach over and get extinguisher. Also, he jumped out of cab immediately after collision in an attempt to save men in the other truck which was also burning."

"Driver badly injured . . . not able to aid in extinguishing the fire."

"Driver thrown from cab . . . could not reach extinguisher."

"We had two fires, but extinguishers were not used because (1) Explosion, and

Types of Fire Experienced by 22 Fleets During the Year 1943.

Extinguishers Carried on Fleet Vehicles	Percentages Given Are of the Total Fire Experiences Reported									
	Fires Involving Fleet Units				Fires in Others' Properties				Total	
	Fire Only		Fire and Accident		Vehicles		Other			
Put out the fire....	22	25.3%	6	06.9%	13	15.0%	4	04.5%	45	51.7%
Controlled the fire..	6	06.9%	2	02.4%	4	04.5%	0	...	12	13.8%
Ineffective	7	08.1%	8	09.2%	4	04.5%	3	03.5%	22	25.3%
Not used	0	...	8	09.2%	0	...	0	...	8	09.2%
Total.....	35	40.2%	24	27.6%	21	24.1%	7	08.1%	87	100%

(2) Truck went off the road and tipped over and caught fire. The driver did not have time to even try to extinguish the flames."

Damage losses were reported only for the amounts sustained by the vehicles and cargoes of the trucking companies, and not for the property of anyone else. A total of $262,667.17 loss was reported for the 59 fire experiences of the 22 fleets, of which $78,421.81 was caused to transports and $184,245.36 to cargoes. The average loss per fire was $4,451.99.

Of the 35 cases which had fire only, 22 were put out with extinguishers at a loss of only $1,352.38, or an average of $61.02 per fire; 6 were controlled with extinguishers at a loss of $9,622.52, or an average of $1,610.42 per fire; and extinguishers were ineffective on 7, of which losses on three were not reported separately. The remaining four totaled $25,011.00, or an average loss per fire of $6,252.75.

For the 24 fires coupled with other accidents there were no loss figures reported separately for the 8 that were put out or controlled with extinguishers. For the 8 in which extinguishers were ineffective, the total was $46,600.00, or an average loss of $5,825.00 per fire. The 8 fires which were not attacked with extinguishers showed no separate loss figures for 3. The remaining 5, however, showed a total loss of $63,389.00, or an average of $12,677.80 per fire.

The accompanying tables show the number, percentage, and dollar loss under the various classifications.

A breakdown of the size of the fleets which returned questionnaires shows that 36.8 per cent operate fleets of less than 25 units, 10.5 per cent operate fleets of from 25 to 50 units, 13.2 per cent operate fleets of from 50 to 100 units, 23.7 per cent operate fleets of from 100 to 150 units, and 15.8 per cent operate fleets numbering 150 or more units. The largest fleet numbered 268 units and the smallest 7 units. The average size of the fleets was 79½ units.

An average of approximately one fire extinguisher per unit was reported, the types of extinguishers carried being as follows:

87.3 per cent — vaporizing liquid
2.4 per cent — carbon dioxide
3.6 per cent — foam
0.8 per cent — dry powder
5.8 per cent — unidentified

Many of the operators feel that the industry does not carry enough extinguishers to provide the protection the investment warrants. Observations by those whose extinguishers were used ineffectively include such comments as:

"In our opinion the fire extinguishers

Fire Damages, in Dollars, Experienced by 22 Fleets During the Year 1943.

Extinguishers Carried on Fleet Vehicles	Dollar Fire Damages to Fleet Units (Vehicles and Cargo)					
	Fire Only			Fire and Accident		
	No. of Fires	Total Losses	Average Loss	No. of Fires	Total Losses	Average Loss
Put out the fire.....	22	$1,352.38	$61.02	6	*	*
Controlled the fire.....	6	9,662.52	1,610.42	2	*	*
Ineffective	4	25,011.00	6,252.75	8	$46,600.00	$5,825.00
	3	*	*			
Not used	0	.....	.....	5	63,389.00	12,677.80
				3	*	*
Total.....	35	*	*	24	*	*

*Loss Figures not reported separately.

on over-the-road units in most fleets, including our own, are entirely too small."

"After the collision both trucks burst into flame, and the one-quart carbon tetrachloride extinguisher was . . . insufficient to control the fire."

"Our driver . . . used the extinguisher, but it was not large enough to take care of the fire."

"We had one unit completely burn on which 2 . . . extinguishers were used, but would not put out or control the fire."

"The fire started due to a flat tire, and the 2½-gallon foam extinguisher was not enough to cool the tire off."

The replies show the following geographical location of fleet headquarters:

Arkansas (1)
California (3)
Colorado (4)
Connecticut (2)
District of Columbia (1)
Hawaii (1)
Idaho (1)
Illinois (8)
Indiana (1)
Kansas (2)
Kentucky (1)
Massachusetts (1)
Michigan (3)
Minnesota (6)
Missouri (5)
New Jersey (3)
New York (4)
North Carolina (5)
Ohio (6)
Oklahoma (1)
Oregon (3)
Pennsylvania (13)
South Dakota (1)
Tennessee (2)
Texas (3)
Utah (2)
Virginia (2)
West Virginia (1)
Wisconsin (4)

Subsurface Foam Application for Tank Fires.

Just as World War II has caused the evolution of newer weapons for waging war, so has it seen the initiation of new developments in the science of fighting and controlling disastrous gasoline and oil fires. One of many new war developments in the field of oil fire extinguishment is the use of foam in subsurface application.

There are three different types of foams now being used for fire-fighting purposes; one, the time-honored standby, chemical foam, which depends on a chemical reaction for its production of foam; two, the newer type, high-expansion, mechanical foam made by the mechanical agitation of air with a dilute solution of synthetic foaming agent; and three, the protein type, low expansion mechanical foams produced by a similar mechanical agitation, but using as a foaming agent a dilute solution of hydrolyzed natural proteins. The latter mechanical foam contains smaller amounts of air and larger amounts of water than the high expansion foams.

Much research and development has been devoted to the application of these foams to the manifold fire fighting problems caused by modern warfare where petroleum products are one of the most important and vital of resources.

The U. S. Navy realized the importance of the newer fire-fighting methods early in the War and several research projects were initiated to provide better methods and equipment for fighting fires aboard ship and at large fueling bases and storage points. One of these projects was the outcome of preliminary trials of a new method of extinguishing large oil tank fires in England, since named the subsurface foam injection method. Its freedom from damageable tank-side installations due to the use of the product line of the tank as the conduit for foam introduction appealed to Naval authorities. Apparently, British fire protection engineers had found only too true what was then feared in this country, that under enemy bombardment, the methods of extinguishing oil tank fires installed during peace time were ineffective in controlling large fires in tank farms.

The information received from England in 1942 concerning this somewhat revolutionary method was not considered complete, and consequently the Bureau of Yards and Docks of the Navy Department in Washington, under the leadership of Captain F. C. Bedell and Mr. M. A. Spamer of the Radio, Marine Corps Storage Section, undertook to determine the usefulness of subsurface foam injection methods of tank fire extinguishment for the protection of Navy fuel storages.

To explore the fundamental physical and chemical properties and engineering design principles of this method a research project was established by the Bureau at the Naval Research Laboratory under the direction of Richard L. Tuve of the Chemistry Division. Since the inception of this project a great deal of small-scale laboratory work has been done on this method and two large-scale field tests have been

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This article, prepared by J. K. McElroy of the N.F.P.A. staff, is intended only to provide present information on new developments and test results. The N.F.P.A. Committee on Special Extinguishing Systems has not as yet considered the subsurface application of foam, and the current N.F.P.A. Standards on Foam Extinguishing Systems contain no provisions on subsurface foam application.—Ed.

conducted, using the design principles evolved by this research.

The results of these tests have been made available to the public by the Navy Department. The oil industry, for many years progressive in fire prevention and fire control activities, may be expected to take advantage of any applicable new developments in methods of fire extinguishment.

Initial Research Developments.

Prior to the first full scale trial on Navy fuel oil at Penniman, Virginia, in July, 1943, the Naval Research Laboratory tests were directed toward the verification of information obtained from England. Small scale laboratory procedures were established, and a large number of tests were made to obtain basic data which would enable a confident approach to the proposed full scale trial. Laboratory tests and other information indicated that foam introduced into a burning fuel tank must be very resistant to heat in order to flow from 50 to 100 feet over the surface in combustion temperatures ranging from 1300° to 2000° F. Laboratory tests of fuel oils used by the Navy also confirmed the fact that the temperature of a hot fuel oil layer (10 to 15 inches in depth below the surface) might be expected to reach 500° F. During the combustion process the temperature of the oil beneath the constantly deepening hot oil layer remained at 80° F.

The early Laboratory analysis of mechanical foam fluids available in the United States in 1943 indicated that they did not possess the necessary qualities for efficient fire extinguishment. The British foam fluid used in the first full scale fuel oil fire test was a hydrolyzed protein foam liquid producing a heavy, low-volume foam of the third type mentioned earlier in this article. The initial research reinforced the decision of the Navy to select hydrolyzed protein foam liquid with inorganic stabilizing salt added, for standard use. The Naval Research Laboratory's initial work suggested that the volume of *water* lifted to the surface by the subsurface method of foam introduction is a significant factor, as oil above 212° F. will boil off the water, thus cooling the surrounding oil. An interesting result of early laboratory trials was that Navy scientists were able to calculate the amount of water in the mechanical foam solution required to lower the temperature of the hot oil in a tank with any given oil surface area and depth, and, by introducing this calculated amount of water in the form of foam, extinguish fires without the foam blanket being present on the surface of the fuel oil.

The Penniman Full Scale Test.

Following the success of controlled laboratory experiments, the Bureau of Yards and Docks and the Naval Research Laboratory arranged for a large field trial at Penniman, Virginia, in August, 1943. A standard, advance-base, bolted-steel tank, 55 feet in diameter and 40 feet high was erected. The test tank contained 32 feet of Navy special fuel oil (approximately 14,000 barrels). Arrangements were made to test the extinguishment effectiveness of the subsurface method by the introduction of British hydrolyzed protein type mechanical foam through the twelve-inch product line.

British equipment, including branch pipes (play pipes) with inductors on the venturi principle, was imported for use in the trial through an early reverse lend-lease arrangement with British authorities. The British foam fluid was a hydrolysis product of hoof and horn meal con-

End of 3-minute pre-burn.

3 minutes after foam pumping start.

Complete extinguishment in 8 minutes 15 seconds.

FINDLAY TEST No. 1

Depth of crude oil in this test 16 ft. 4 in. above foam inlet. Mechanical foam injection at two points diametrically opposite. Note mobile pilot model foam maker in foreground with single discharge connection to the 12 in. product line.

taining inorganic stabilizing salts. Using the British branch pipe equipment at no induced back pressures, approximately 4 gal. per min. of the fluid with 120 gal. per min. water at 100 lbs. per sq. in. would be expected to produce 1000 gal. per min. of foam. Experimental work in the Laboratory showed that this would not be the case where foam is discharged against pressure, since the apparatus shows progressively poorer efficiency with increased pressure demand on the foam-producing branch pipes. However, this was taken into account in the Penniman test.

In the large-scale fuel oil test the foam was introduced into the product line 600 feet from the tank. In order to generate a definite heat wave of hot oil the oil in the bolted steel tank was allowed to burn for fifteen minutes. Foam was then delivered to the product line, using the four play pipes, and the fire was extinguished in 7½ minutes. Foam was applied for an additional 2½ minutes, resulting in a completed foam blanket. Two hundred gallons of the British foam fluid were consumed.

This first successful large scale experiment in subsurface application may be summarized as follows: The large scale trial confirmed the results of the small scale tests and indicated that it is a basic necessity in oil fires of this type that water in substantial amounts contact the burning surface. Heat dissipation can occur at maximum efficiency when the foam (bearing the water) only contacts *cold* oil in its travel to the burning surface as compared with passage through the surface heat *above* the burning oil. Froth development resulting from the subsurface method used in the test was six to eight inches for each inch of hot oil in the hot wave layer. Foam was injected into the product line of the tank 600 feet distant from the fire without suffering a complete breakdown of the foam by transmission through the product line.

Further Research Developments.

The report (NRL P-2182) issued by the Naval Research Laboratory following the Penniman Test recommended that further experimental work should be initiated along the following lines:

1. A study of foam-forming agents to obtain domestically a foam fluid capable of increased water retention and stability.
2. Investigation of the usefulness of the subsurface method in the protection of low boiling point range hydrocarbons such as gasoline.
3. Investigation leading to the development of newer types of foam-making apparatus less cumbersome in operation than that used in the Penniman Tests. The apparatus must also give better control over the ultimate characteristics of the foam produced. The development of a mobile foam making apparatus would make possible more rapid application at the scene of a tank fire.
4. Investigation leading to the improvement in the methods of proportioning of foam fluid in the water stream.

It was considered by the Bureau of Yards and Docks that the Penniman trial had demonstrated the practical effectiveness of the subsurface method, and it was, therefore, decided to continue with laboratory and other experiments which would improve the methods found to be reasonably successful in the full scale trial.

Basic research and experimentation during this period at the Laboratory evolved a new type foam fluid very similar in some respects to the British mechanical foam fluid. With the cooperation of the domestic manufacturers of foam fluids this superior material was made available and a standard specification was created for its use throughout the Navy for surface

View of retrogression of foam blanket over inlet following cut-off of mobile foam maker. This photograph, taken during high level dry run test made prior to fire tests at Findlay, shows the meeting of the foam blankets in two-point application.

hydrocarbon fire fighting as well as the contemplated subsurface injection application.

At the same time, hundreds of small scale laboratory test fires using the subsurface injection method were run under controlled conditions of foam composition (air vs. water), foam characteristics, such as viscosity and water retention, addition rate to the burning surface and damage to high quality fuels such as 100-octane aviation gasoline by the passage through them of such foams.

The outcome of this work was the discovery that the extinguishment of even gasoline tank fires was entirely practicable by the subsurface method if a particular type of mechanical foam could be generated for injection into the tank. This foam was required to be of high water content, between 23% and 33%, with an expansion ratio between 4.35 and 3.0. It must also be very stable with respect to its rate of loss of water, thus leading to a very fine-grained, small bubble-sized air emulsion, with a viscosity low enough to permit its flowing over large surfaces of burning liquid without "piling up."

In order to verify these conclusions concerning materials and methods the Bureau of Yards and Docks financed, through the Laboratory, the building of a mobile foam generator, producing 4000 gal. per min. of foam of a quality suitable for the extinguishment of fires in Navy fuel tanks by the subsurface method. This mobile unit was built through the wholehearted cooperation of industry as it was a pilot, experimental fabrication.

Findlay Full Scale Subsurface Tests.

In cooperation with the Standard Oil Company (Ohio), the Navy Department initiated a second series of full scale tests using the subsurface application method applied to large storage tanks. These tests were conducted at the Moorehead

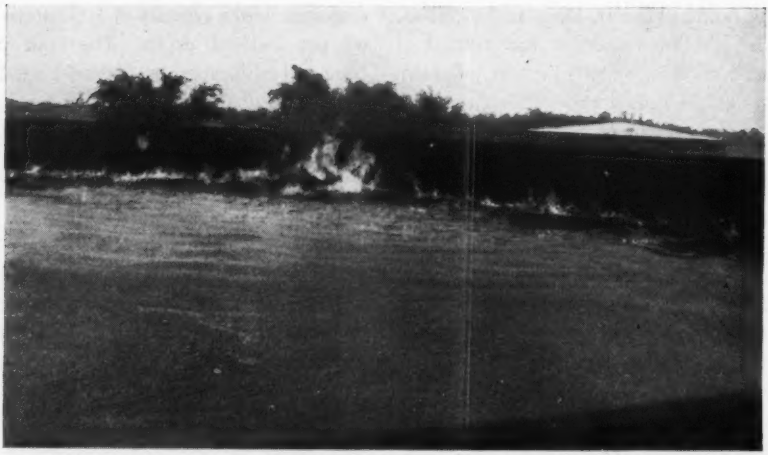
tank farm at Findlay, Ohio, in July, 1945.

In addition to testing the method of introduction by the injection of foam through the 12-inch product line, the trials were devised by the Navy to test the effectiveness of the newly developed pilot model foam maker designed to produce, under pressure, foam which has a homogeneous bubble structure. Earlier test results had indicated that the number of points of subsurface discharge into large tanks might be an important factor, and the tests were, therefore, arranged so that application could be made at either one point or at two diametrically opposite points.

The tank used in the test was 93 feet in diameter, with a capacity of 109 barrels of oil per inch of depth. The tank was equipped with emergency standby topside mechanical foam protection. Water supply was taken from a near-by tank of equal capacity.

The pilot model foam maker was designed to operate continuously for 17 minutes without refilling with foam fluid at full 4000 gal. per min. foam generation. The equipment included an air compressor to produce compressed air at 60 lbs. per sq. in., a centrifugal pump of 1000 gal. per min. capacity at 60 lbs. per sq. in., and a positive displacement foam fluid pump so arranged that a constant foam fluid percentage of 6% in the water stream was

The 93 ft. test tank with "Y" branches to permit tests with two-point subsurface application. Note check valve in 12-inch product line (normally underground) in foreground. The Moeller tube emergency top-side protection provided is at top center of the test tank. Findlay, Ohio, July, 1945.



Typical view of tank used in Findlay tests. Foam blanket sealing off remaining flames on crude oil, 16 ft. 4 in. above foam inlet, after 3½ minutes foam generation. Pumping continued for an additional 3½ minutes in this test and the test fire was extinguished and apparatus secured 1 minute and 15 seconds later.

obtained. One thousand gallons of foam fluid were available in built-in tanks on the truck body. Previous laboratory tests indicated that a controlled foam of particular physical characteristics containing a 6% mechanical foam solution was the desired optimum, and a cylindrical foam mixer designed to produce an emulsion of these characteristics was installed on the truck.

The foam fluid used in the tests was the protein type provided in accordance with Navy specification.

It was decided that the Navy series of tests at Findlay would involve two procedures. First, "dry run" tests were made to observe the probable distribution of foam over the surface of large tanks and to study the effect of turbulence from the subsurface injection. It was important that sufficient foam be provided to complete extinguishment after the foam maker was cut off, and turbulence in the tank had subsided. Earlier Laboratory tests indicated that the Navy specification foam fluid would provide a "flowable" foam which spread rapidly and would completely cover the surface of the tank following cut-off of foam injection. Secondly, full scale fire extinguishment tests were made with Illinois crude oil. One significant fire test was made in which 40,000 gallons of gasoline were floated on the surface of the crude oil in a ten-inch layer. Summaries of the Navy tests are given in the table on page 316.

Summarizing the conclusions of the results of the tests the Naval Research Laboratory report states "that extinguishment occurred in every case and under every variable condition in which this test was run, and it is concluded that the application of the subsurface foam injection method to the extinguishment of fuel tank fires is a perfectly practicable process." The report further states that the tests show "that contamination of the foam blanket does not occur to such an extent that it will not form a blanket and ultimately extinguish the fire, provided, how-

ever, that this foam is of maximum stability and of correct air-water ratio."

Another important fact developed by the tests is that complete extinguishment in crude oils and gasoline did not occur until cooling of the surface of the oil and tank walls in contact with the wet foam was achieved. This cooling action requires sufficient foam pumping time to enable a blanket of foam to remain following the cessation of turbulence due to pumping. Sufficient foam must be delivered to secure the cooling action so that the residual foam blanket will cover the oil surface and remain essentially undamaged.

The conclusions of the work at the Naval Research Laboratory and the large-scale fire tests conducted by the Navy using the subsurface method are given in a report No. P-2679 in which it is stated:

"(a) The subsurface injection method will efficiently extinguish crude oil of fuel oil tank fires using foam rates of .45 to a maximum of .75 gal. per min. per sq. ft. applied through one inlet or two if available.

"(b) The subsurface injection method will efficiently extinguish gasoline fires, using similar foam rates, but with a minimum of two points of injection on the tank if its size approaches 93 feet in diameter.

"(c) The subsurface injection method may be used on tanks whether partly full or completely full of fuel. The only factor introduced being an increased length of time of extinguishment in the case of a partly filled tank, due to wind currents.

"(d) The subsurface injection method requires apparatus and liquids of such design that a foam of controlled physical and chemical characteristics is produced.

"(e) The subsurface injection method requires only the addition of a branched "Y" connection with suitable valves on existing product line installations for foam introduction. This point may be at distances of 200 feet or more from the tank and may be well protected from the fire."

The period from the conclusion of the Findlay fire tests in July, 1945, to the present writing has been taken up with the procurement by the Navy of an improved form of pressure-foam generation equipment utilizing positive displacement rotary pumps for water, fluid and air. A pilot experimental model of such a unit has been made by an American pump manufacturer. This device should be practically foolproof in operation, requiring only that the operator secure the outlet of the unit to the product line and run the engine at a specified speed, thus producing a controlled quality and quantity of foam. The new unit is designed to deliver 2000 gal. per min. of foam, is much lighter than the original pilot model and consequently will have greater mobility.

The Use of Chemical Foam for Subsurface Injection.

Many fire protection engineers having large stocks of chemical foam compounds already on hand will be naturally interested in the possibilities of using chemical foam for subsurface injection instead of incurring an additional expense to equip their plants with mechanical foam fluid and equipment similar to that used by the Navy in these tests. To answer such queries a full-scale subsurface test using chemical foam was run by a foam manufacturer on the same tank at Findlay used by the Navy in their tests. The results of this trial are best given in chronological form as follows:

Conditions of Test

Preburn—3 minutes.
Test Fuel—Crude oil.
Fuel Depth—16 feet, 4 inches.

Equipment Used

One Dual Powder Generator.
Topside Moeller Tubes (Two).

Beginning foam pumping period.

3½ minutes after foam pumping start, single point application.

9 minutes after foam pumping start, two-point application.

FINDLAY TEST No. 3

Crude oil, depth 18 ft. 11 in., with 10 in. gasoline floating on top. Single point application first 5 min. pumping, two-point application for additional 7 min. Fire completely extinguished in 13 min. 45 secs.

Operating Test Conditions

Foam Expansion—8.
Foam Application—2640 g.p.m.
Water Consumption Rate—330 g.p.m.
Rate of Powder Consumption—1 can A plus 1 can B per minute.

Extinguishment Log

0 min.—Chemical foam applied, two inlet subsurface application.
3 min.—First indication of control.
7 min.—Changed to one inlet application.
10 min.—Fire burning heavily on west half of tank, opposite inlet.
12 min.—One-half of chemical foam unit plugged and unit shut down, complete ignition of tank surface resulted.
14 min.—Chemical foam unit again in operation.
17 min., 30 sec.—Chemical foam unit again plugged, pumpers shut down. Chemical foam abandoned.
19 min., 30 sec.—Emergency topside application mechanical foam unit with Moeller tube put into action.
20 min., 30 sec.—Second emergency topside application mechanical foam unit with Moeller tube put into action.
32 min., 28 sec.—Fire extinguished.
Total chemical foam subsurface application—15 minutes.
Total mechanical foam topside application—13 minutes.
Water consumption of the two topside Moeller Tube Units—480 g.p.m.
Foam fluid consumption of two Moeller Tube Units—28.8 g.p.m.

It will be noted from the data above supplied by the foam manufacturer to the Navy that the chemical foam subsurface injection test was unfortunately incomplete due to mechanical failure of the dry powder foam generator used. Observers at the test suggest that the chemical foam might have been successful, given sufficient time of application. However, based on the data provided by the foam manufacturer, we have calculated the rate of application of the chemical foam in this test and find that the calculated rate, 0.388 gals. per min. per sq. ft., is lower than the current N.F.P.A. standard for rate of application and also lower than the application rate obtained in the tests using mechanical foam. The Naval Research Laboratory report does not indicate the reason for the application of less than standard rates for the chemical foam subsurface test.

Peacetime Possibilities.

There are two basic requirements for the use of the subsurface injection method of extinguishment of oil and gasoline tank storage fires. First, an adequate water supply must be available. Second, pressure foam-making apparatus of adequate capacity with the necessary foam fluid must also be available. The provision of foam makers which will operate against high hydraulic heads is no longer a bar to the use of mechanical foam. The development program in both Britain and America in the manufacture of foam makers, whether by aspiration or air compression, has progressed to the point where procurement of the necessary apparatus is presently possible or will be possible in the near future.

The data available in the various tests show that under the present test conditions mechanical foam has certain advantages over chemical foam whether used in topside or subsurface application. However, mechanical foam facilities must be as carefully designed and engineered as other types of foam systems if they are to give comparable protection. Fewer men are required to operate well-designed mechanical foam makers, hence there is less likelihood of confusion, which should tend to reduce the possibility of interruption of service. The weight of mechanical foam fluid required for a given volume of water is much less than the weight of dry chemicals required, hence less material need be stored and transported to the scene of the fire.

The petroleum industry may find that

additional 7 min. Fire completely extinguished in 13 min. 45 secs.

Navy Subsurface Test Data.

Conditions of Test	Test No. 1	Test No. 2	Test No. 3	Test No. 4[2]	Test No. 5[2]
Pre-Burn	3 min.	3 min.	3 min.	3 min.	3 min.
Test Fuel	Crude Oil	Crude Oil	Crude Oil with Motor Gasoline on top.	Crude Oil and Gasoline Residue.	Crude Oil
Fuel Depth (above foam Inlets)	16'-4"	16'-4"	Oil 18 ft. 11 inches Gasoline 10 inches	2'	2'
Tank Outage	6'	6'	6'	20'-4"	20'-4"
Number Inlets	2	1	1—First 5 min. 2—Second 7 min.	2	1
Operating Test Conditions					
Foam Inlet Pressure to Product Line	12 p.s.i.	14 p.s.i.	13 p.s.i.	11 p.s.i.	12 p.s.i.
Foam Fluid Concentration	5.6%	5.0%	5.6%	5.7%	6.0%
Foam Expansion	3.4	3.4	3.4	3.3	3.4
Foam Application Rate (calc.)	0.47 g.p.m./ sq. ft.	0.525 g.p.m./ sq. ft.	0.465 g.p.m./ sq. ft.	0.44 g.p.m./ sq. ft.	0.44 g.p.m./ sq. ft.
Total Foam Application (calc.)	3220 g.p.m.	3600 g.p.m.	3200 g.p.m.	3000 g.p.m.	3000 g.p.m.
Water Consumption Rate	950 g.p.m.	1050 g.p.m.	950 g.p.m.	920 g.p.m.	880 g.p.m.
Total Volume Foam Liquid Used	370 gals.	580 gals.	636 gals.	580 gals.	700 gals.
Time Data					
Fire Under Control[4]	3 min.	3 min., 20 secs.	8 min., 30 secs.[1]	8 min., 30 secs.	5 min.
Foam Pumping Time	7 min.	11 min.	12 min.	10 min., 58 secs.	(1st) 9 min. 10 secs.[3] (2nd) 5 min
All Flames Extinguished (Apparatus Secured)	8 min., 15 secs.	12 min., 50 secs.	13 min., 45 secs.	12 min., 58 secs.	25 min., 37 secs.

[1] At 5 minutes one point application determined insufficient.

[2] Observation of conditions in low level tests made determination of accurate time intervals difficult.

[3] 10 min., 27 secs. interval between pumping periods. Initial pumping time 9 min., 10 secs. tried, and interval of 4 minutes allowed for the blanket to close over. This was not successful and pumping was reinstituted for 5 minutes.

[4] Purely arbitrary stage in extinguishment process selected as point when greater proportion of the extinguishment had been achieved and a stage at which properly equipped fire fighter could approach the fire with hand lines or portable foam producing devices.

in the initial cost for comparable protection there may be small difference in the cost of provisions needed for subsurface mechanical foam systems; the conventional two solution wet (chemical) foam systems; or the portable powder generator (chemical) foam systems.

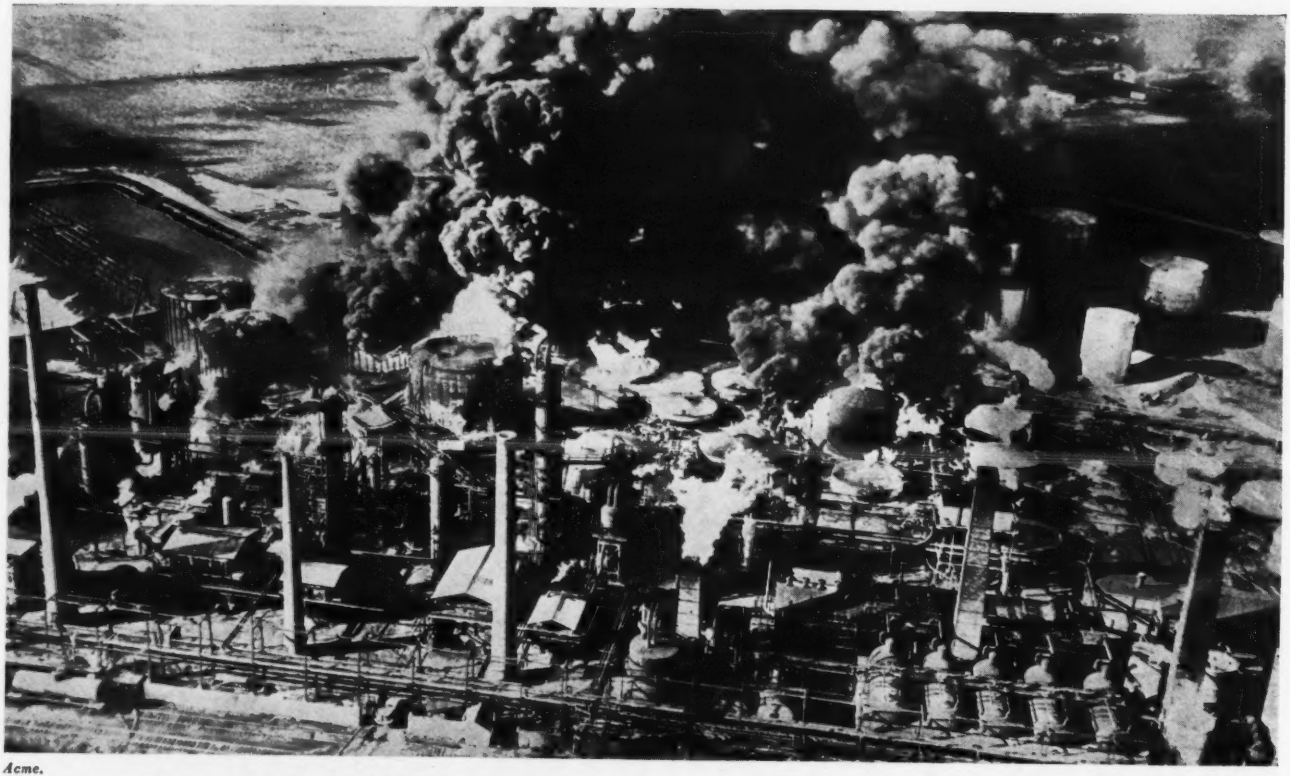
Presently available information has not satisfactorily resolved the problem involving the relative effectiveness of high-expansion and low-expansion mechanical foam. Both types have been successfully used to extinguish large scale oil tank test fires. The only basic research data available on the merits of the protein type of foam fluid are the results of a large number of small scale laboratory tests at the Naval Research Laboratory and elsewhere in the Army and the Navy. These data are not presently available in published form. The joint Army-Navy specification JAN C-266, 4 December 1945, entitled "Charges, Fire Extinguisher (Foam. Mechanical), Type 5," is a specification for protein type foam fluid based on the results of the tests conducted by the Army and the Navy.

Foam fluids in use until recently were formulated to provide a 6% solution with water. Recent developments in Britain and America have made 3% foam fluids possible. Laboratory tests on the 3% solution on the scale of the Naval Research Laboratory program in connection with 6% solutions have not been conducted in this country. The 3% solution, if found satisfactory, offers further economy in storage in warehouses or on mobile mechanical foam generators.

There is no doubt that improvement in the design of foam makers for the production of mechanical foam will receive additional impetus due to the increased interest in this fire fighting medium. Foam makers meeting basic requirements should be useful for either topside or subsurface application. Mobile apparatus capable of being operated by tank farm fire brigade personnel with minimum training and maximum simplicity is expected to evolve from experimental work in progress both in Britain and America.

The Navy Department, exercising proper concern for the protection of above-ground storage tanks from large scale bomb damage possibilities, believes that the subsurface method of extinguishment through product lines is less subject to external damage than topside installations and will result in greater personnel protection. The results of laboratory tests and large scale trials have shown that subsurface extinguishment is a practical method, and the Navy Department is proceeding to the provision of subsurface protection and new type mobile foam making equipment.

The results of the Naval Research Laboratory small scale and large scale trials suggest that a critical and more fundamental scientific approach to the testing of foam fluids and foam makers may result in further economies in the industrial field regardless of military requirements.



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National Oil Refinery Co. plant, Findlay, Ohio, Jan. 16, 1946, during disastrous fire which followed an explosion in an asphalt storage tank.

National Oil Refinery Co. plant, Findlay, Ohio, Jan. 16, 1946, during disastrous fire which followed an explosion in an asphalt storage tank.

Findlay, Ohio, Oil Refinery Fire.

The exact origin of a disastrous fire which occurred in the National Oil Refinery Plant at Findlay, Ohio, January 16, 1946, is unknown. Three men died from third degree burns following the fire. Two were refinery employees working in the cracking control room and the third was a telephone repairman engaged in the repair of a telephone extension in the pressure still area.

A series of storage tank explosions and fires followed a violent explosion at 9:10 A.M. in a 12,000-barrel asphalt tank located in the storage tank area. Fire immediately flashed to adjacent tanks and the one-story, brick, metal-roofed pump house in the cracking unit area. More than 50 large tanks of gasoline, asphalt and kerosene were exposed to fire damage, as there were many with substandard spacing and lacking proper dikes. The explosion of the asphalt tank is believed to have been due to a sudden increase in vapor pressure which caused violent rupture of the tank, though the factors contributing to the excessive pressure were not possible to determine.

Eleven of the fifty tanks exposed were destroyed, including the asphalt tank originally involved, three kerosene tanks, four lubricating oil tanks, one gasoline tank and two tanks used for the storage of heavy fuel oil. The tanks ranged in size from 1,000 to 17,000 barrels capacity. Severe structural damage to several tanks undamaged in the fire was discovered on inspection several days after it occurred. One such tank was more than 200 feet from the point of the detonation.

The first alarm was given by a telephone company supervisor from the telephone building one mile distant from the fire.

Press Association, Inc.

National Refinery Co., Findlay, Ohio, January 16, 1946. Lack of dikes permitted burning oil to flow throughout the area.

The supervisor happened to be looking out her office window and saw the original explosion. Some delay occurred in the transmittal of a telephone alarm to the Findlay Fire Department from the plant, believed due to damage to the telephone circuits from the explosion.

The Findlay Fire Department responded immediately to the telephone company supervisor's alarm with three engine companies, augmenting the refinery fire brigade equipped with two additional pumpers and portable chemical foam generators. By 10:15 A.M. the supply of chemical foam powder available at the plant was nearing exhaustion. As the fire reached large proportions very rapidly, it was soon apparent that additional equipment and manpower would be required to cope with the situation, and additional equipment and supplies of foam powder and mechanical foam were rushed from Lima, Cleveland, and Toledo. Late in the afternoon, as the fire continued to progress unchecked, a carload of foam powder was ordered forwarded to Findlay by passenger train schedule from Elmira, New York. The Standard Oil Company (Ohio) refinery fire brigade from Lima responded to a call for assistance during the morning without their dual foam generator, and an airplane was dispatched to Lima for the missing equipment and an additional deluge nozzle. The Toledo Standard Oil Company (Ohio) refinery fire brigade also responded to an early call for assistance. The Nickel Plate railroad foam car was rushed to the scene from Lima.

Firemen were seriously hampered by an inadequate water supply and lack of hydrants. The lack of dikes to confine burning liquids was an important factor in the widespread destruction. It is reported that the temperature of water supply (41° F.) had an adverse effect on foam generation. Two portable chemical foam generators were lost during the fire, which was finally brought under control after seven hours of combined efforts by the Findlay Fire Department and the refinery fire brigades.

Sixty thousand pounds of chemical foam powder and 1500 gallons of foam fluid were used in the control of this fire. The mobility and the effectiveness of the mechanical foam equipment were important factors in the final extinguishment of the fire, particularly after the chemical foam generators had to be abandoned.

The monetary loss is estimated to be between $400,000 and $500,000. But for favorable wind conditions, which helped to prevent the spread of fire between the refinery and the crude oil storage tanks, fire damage might have been much heavier. The difficulty in obtaining replacement equipment for the heavily damaged cracking unit has resulted in delay in returning the plant to operation until April.

Texas Court Upholds NFPA Standards.

A case which has important bearing on several phases of the application of N.F.P.A. and other similar standards used as a basis for law was recently passed on by the Supreme Court of Texas. The majority opinion of the court, handed down on March 20, 1946, upheld the reasonableness of the adoption of such standards by reference. It further supported the idea, without saying so in so many words, that fictitious considerations of fire hazard should not be invoked to secure results that might be quite properly obtained by clear-cut zoning laws. Zoning laws exclude certain business operations from residential areas because the particular business may be obviously undesirable for a variety of reasons, only one of which may be the fire hazard involved.

The case in question required the Texas Court to affirm or reject the findings of a court of civil appeals. This appellate court refused to support an injunction to prevent the erection, in a suburb of Greenville, Texas, of two tanks at a bulk station for the storage of butane gas.

A group of owners of residences, the nearest approximately 128 feet from the proposed tanks, asked that the tanks be declared a nuisance because of the fire hazard involved. The court's majority opinion declared that the nuisance angle could not be substantiated because the installation obviously conformed to the limitations of the N.F.P.A. Standards on Liquefied Petroleum Gas as promulgated by the National Board of Fire Underwriters' Pamphlet No. 58.

The majority opinion also upheld the adoption of the N.F.P.A.-National Board Standards by reference and made a strong statement of the case for such adoption by reference. This is of interest because there has been a trend of court decisions in Texas in support of the contrary view which was argued by three of the justices, who filed a dissenting opinion to that of the other six.

The majority opinion established that there was no unconstitutional delegation of legislative authority in the course adopted by the state legislature of authorizing the Railroad Commission of Texas to adopt the N.F.P.A.-National Board Standards on Liquefied Petroleum Gases. This decision is the more significant because the minority justices argued, with a good deal of merit, that the wording by means of which the adoption was effected, was faulty. There could be no objection, they reasoned, to the formal adoption of the N.F.P.A. standards by due process which would include formal action on the regulations by the Texas legislature and publication in full. The most valid criticism offered to the wording under which the rules were adopted, was that the Texas Railroad Commission was given authority only to adopt a specific standard. They could have had no basis for reasoning that there was a tinge of unconstitutionality in the adoption of these standards if the law had simply empowered the Railroad Commission to exercise its own judgment in deciding what standards to adopt.

However, the support of the majority opinion for the idea of adopting any reasonable and generally accepted standard (such as the N.F.P.A.-National Board standards) is important because it shows that the court is not too much impressed by the mere detail of wording of the law.

The reasonableness of the legislature's intent is accepted.

The N.F.P.A. Standards on Liquefied Petroleum Gases specify minimum distances between tanks for liquefied petroleum gases and the nearest important buildings or group of buildings. The tanks in question were 8400 gallons and 10,000 gallons respectively. For these, the minimum distance in the standards adopted by the Railroad Commission of Texas is 50 feet, with the additional provision that the Railroad Commission act as the inspection department having jurisdiction to specifically approve the location of larger sizes. This, the majority opinion held, defined the factor of location with respect to other buildings satisfactorily for the purpose of coping with any fire hazard or nuisance from hazards involved. The Railroad Commission had definitely approved the location. The minority justices attacked the fact that the Railroad Commission apparently did not specifically approve the location until the action for an injunction was threatened.

The dissenting justices belabored the factor of location. The location could have been attacked and it is quite likely that a case could have been made for the fact that a business occupancy of this sort might be an undesirable addition to a residential district. The petitioners could not get the majority of justices to agree, however, in the light of compliance with a reasonable set of safety standards, that the business constituted an unreasonable fire hazard.

We have seen many cases of this general sort where the petitioners might have been successful in excluding a business occupancy from a residential district if it had been attacked on a broad basis with the same considerations that are employed to establish zoning requirements. Members of the N.F.P.A. staff, for example, on numerous occasions have been requested to testify as to the fire hazard of proposed installations of gasoline tanks at bulk storage stations and similar locations. Usually those soliciting such aid have wanted to establish the fire hazard as the reason for the exclusion of the tanks in question from the location in point. However, there are other considerations. Gasoline or butane, for example, contribute to the convenience and comfort of a community and are necessary for transportation, heat, and power.

Furthermore, by observing accepted standards such as those af the N.F.P.A., the fire hazard can be kept within reasonable limits so far as the public safety is concerned. It is encouraging to note that the majority justices of the Texas Supreme Court were not misled, and their decision will be generally supported by fire protection authorities.

The case in question was that of R. G. Dudding *et ux. v.* Automatic Gas Company, and the decision of the Texas Supreme Court was dated March 20, 1946. We are indebted to Mr. Eugene Sanders, Fire Prevention Chief of the State Fire Marshal's Office in Texas, for procuring for us a verbatim transcript of the majority and minority opinions. These are contained in the Texas Supreme Court Reporter, March 23, 1946 (Volume 15, No. 26, pages 245-253). The following extracts from the majority decision include the points of particular interest to N.F.P.A. members:

* * * *

The case is before this Court solely on the question of the propriety of issuing an injunction to restrain the proposed construction of respondent's tanks.

In their argument petitioners affirm that "there is only one matter involved in this case

and that is as to the location of the 20,000 gallon butane gas tanks, and whether located as they were, they constitute a nuisance."

It is not disputed that the respondent is engaged in a lawful business and has fully complied with all applicable rules and statutes, except only it is urged that the regulatory powers contained in the act from which we will presently quote do not extend to an approval of the location of respondent's tanks. Accordingly, our inquiry narrows to a consideration of the regulations which assume to permit the location of these tanks within certain minimum distances from adjoining and near-by property.

In 1939 the Legislature passed a comprehensive regulatory statute to prevent the improper handling and use of liquefied petroleum gases, which enactment included the following:

"After the effective date of this Act all containers and pertinent equipment installed for use in this State for the storage and dispensing of liquefied petroleum gases for the purpose of providing gas for industrial, commercial, and domestic uses, shall be designed, constructed, equipped, and installed as specified under the published regulations of the National Board of Fire Underwriters for the design, installation and construction of containers and pertinent equipment for the storage and handling of liquefied petroleum gases as recommended by the National Fire Protection Association, effective July, 1937, a copy of said regulations known as National Board of Fire Underwriters Pamphlet No. 58 being on file with the Gas Utilities Division of the Railroad Commission of Texas." Sec. 2a, Art. 6053, as amended Acts 1939, 46th Leg., p. 501 (Sec. 2-a, Art. 6053a, Vernon's Rev. Tex. Stat.).

Pamphlet No. 58, adverted to in the act, includes the following regulation:

"B.5 Location of Containers and Regulating Valves.

(a) * * * Except as herein provided, each individual container shall be located with respect to nearest important building or group of buildings or line of adjoining property which may be built upon in accordance with the following table:

MINIMUM DISTANCE

Water Capacity per Container	Underground	Aboveground
Less than 125 gallons.....	10 feet	None
125 to 500 gallons.....	10 feet	10 feet
500 to 1200 gallons.....	25 feet	25 feet
Over 1200 gallons	50 feet	50 feet

Aboveground containers of capacity exceeding those shown in the above table may be installed close to buildings or property lines when specifically approved by the inspection department having jurisdiction."

The Railroad Commission of Texas was designated as the agency to administer this act. It promulgated rules which substantially conform to the statutory standards. These rules include a provision that the particular containers which respondent proposes to erect "shall be located and installed in accordance with specific approval obtained from the Railroad Commission of Texas." This approval was obtained. Moreover, the tanks were located substantially farther than the minimum of fifty feet from near-by structures, which as we have seen was expressly approved as a criterion by the Legislature itself. Manifestly, one of the many factors which concerned the lawmakers in enacting this statute was the location and spacing of tanks for the storage of butane gas, and by its adoption of this pamphlet the Legislature effectively laid down definite standards as to spacing. The respondent has fully complied with these standards as well as with the rules of the Railroad Commission.

It was entirely proper for the Legislature to adopt, for the guidance of the Railroad Commission in administering the act, standards theretofore prescribed by the National Board of Fire Underwriters. Nor is the statute invalid because the standards thus adopted were not copied into the act but were incorporated into it by reference to a document then on file with the administering agency. Ex parte Gerino, 143 Cal. 412, 77 Pac. 166, 66 L. R. A. 249; State of Washington v. Bonham, 93 Wash. 489, 181 Pac. 377, L. R. A. 1917D, p. 996; Gima v. Hudson Coal Co., 106 Pa. Super. 289, 161 Atl. 903, affirmed 310 Pa. 480, 165 Atl. 850. The very first article of our Revised Statutes adopts by reference the common law of England and we apprehend that none would question its validity. Interestingly in point is an observation of the Supreme Court of Georgia in Central of Georgia Railway Co. v. State, 104 Ga. 831, 31 S. E. 531, where the court was considering the validity of an adoption act putting into effect a recodification of the statute laws of Georgia. The point had been urged that the measure was invalid because the new code was not copied at length into the act adopting it, and hence offended against the constitutional provision requiring that before final passage bills should be read in each house of the Legis-

lature on three several days. After calling attention to Georgia's statutory adoption by reference of (1) the common law of England, (2) the equity jurisprudence in force in that country, and (3) the American experience table of mortality, the court observed:

"Similar instances might be mutliplied to such an extent as to show that a tremendous breach, if not a total wreckage, of our system of laws, would be accomplished if the judicial construction contended for in this case were placed upon the constitutional provision above quoted."

Also illustrative of the constitutional power of a state legislature to enact such a measure as is here under consideration, we quote the following from L. A. Thompson Scenic Railway Company v. McCabe, 211 Mich. 133, 178 N. W. 662, in which the Supreme Court of Michigan made a distinction between the scope of the legislative powers of the City Council of Detroit and those of the Michigan Legislature:

"Reliance is placed by the defendant upon Act No. 174 of the Public Acts of 1917, by means of which it is said, the State Legislature adopted the 'Boiler Code of the American Society of Mechanical Engineers' by reference only. The propriety of this method of legislation has never been questioned, so far as we are advised; but, assuming its entire constitutionality, it should be borne in mind that the Legislature of the state functions under broad constitutional limitations, whereas the common council of the city of Detroit must act strictly within the powers granted to it in the charter."

The adoption of the regulations in question is not open to such an objection as was urged in State v. Crawford, 104 Kan. 141, 177 Pac. 360, 2 A. L. R. 880, a criminal case where a statute adopting present as well as prospective rules of an unofficial association as a standard of conduct, departure from which would be punished as a crime, was held invalid. It is true that the 1939 enactment also authorized (but did not require) the Railroad Commission of Texas "to adopt and promulgate such rules and regulations as may be hereinafter adopted and published by the National Board of Fire Underwriters and/or the National Fire Protective Association" for the handling of liquefied petroleum gases. But the matter of adopting future rules is not in this case. What we are now considering is the validity of that set of rules which was adopted by the lawmakers when they gave legislative sanction to Pamphlet No. 58 from which we have quoted. We do not have before us a situation where future rules of an unofficial agency have been prospectively adopted by the Legislature or the Railroad Commission. To the contrary, we have here a document containing comprehensive regulations for the safe handling of liquefied petroleum gases which was on file among the archives of the Railroad Commission, and which the statute expressly approved. The adoption of these rules in this manner was certainly a valid exercise of legislative power.

It follows from what has been said that the installations which respondent proposes to construct have been effectively legalized, and accordingly their erection could not have been abated as a nuisance. The applicable rule is well put in 39 Am. Jur., p. 478. We quote:

"Generally, the courts will not hold conduct to constitute a nuisance where authority therefor exists by virtue of legislative enactment, and there are numerous statements in the cases to the effect that the doing of that which the law authorizes cannot be a nuisance, or such a nuisance as to give a common-law right of action, although it would otherwise be one. It has also been held that when the legislature directs or allows that to be done which would otherwise be a nuisance, it will be valid on the ground that the legislature is ordinarily the proper judge of what the public good requires, unless carried to such an extent that it can fairly be said to be an unwholesome and unreasonable law."

* * * *

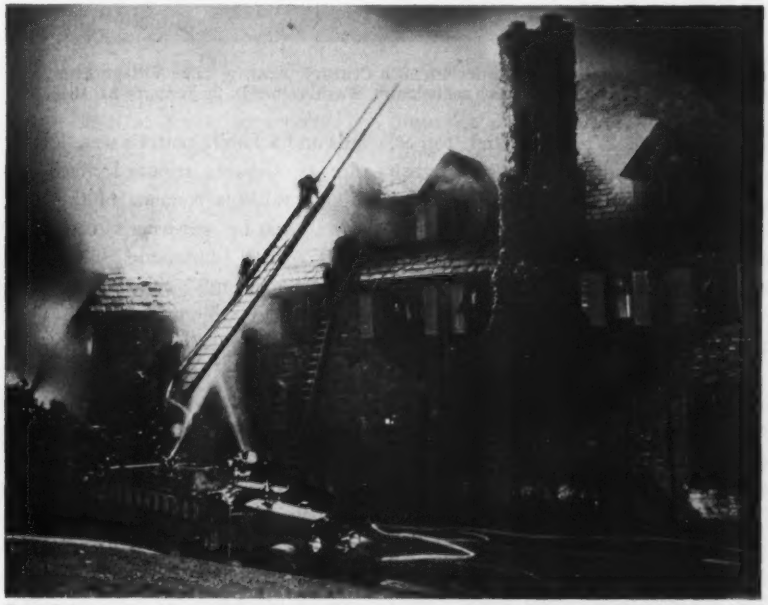
Complaint is made in effect that the Railroad Commission of Texas is undertaking to adjudicate the rights of the parties. We cannot give assent to this contention. Obviously the Legislature has no facility through which to administer the workings of the butane gas regulatory act. What the lawmakers did was to delegate to the Railroad Commission this task and to charge that agency with the duty of putting into effect the statute's complete provisions. There was no attempt to delegate to the Commission any judicial power, nor has that body in any sense undertaken to adjudicate the property rights of the parties. All it has done in this case is to undertake its statutory duty of administering the act. This was entirely proper. Housing Authority v. Higginbotham, 135 Tex. 158, 143 S. W. (2d) 79, 130 A. L. R. 1053, and cases there cited.

The Guggenheim Mansion Fire.

Delayed discovery and the distance to city fire hydrants from the $500,000 Col. R. M. Guggenheim mansion, located on a 23-acre Washington, D. C., estate, were the major factors responsible for a fire loss estimated to be in excess of $750,000, reported to be the largest residential loss in the history of the national capital.

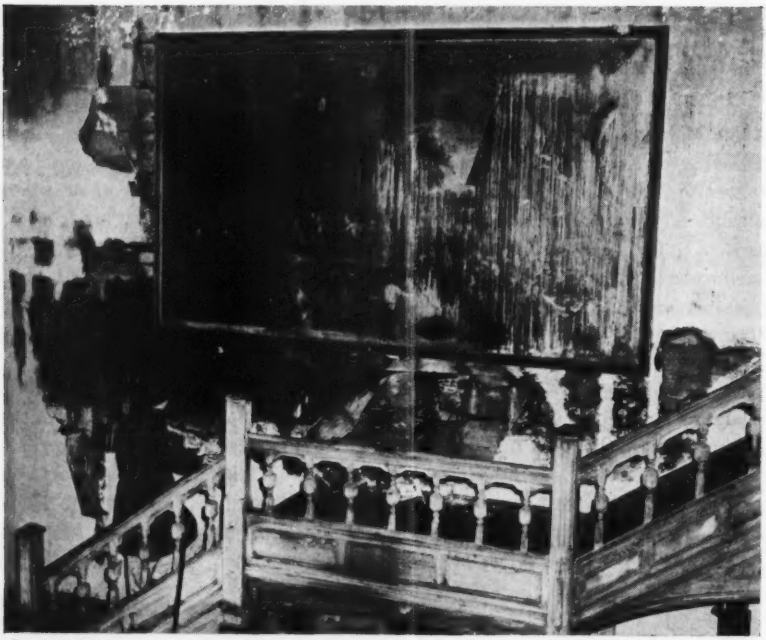
The exact cause of the fire is unknown, as it was well underway when Col. Guggenheim's valet discovered it at 1:30 A.M. January 30th, 1946. It is believed certain that the fire originated in the first floor drawing room, spread to a near-by wood bookcase, broke through the plywood backing for the bookcase and rapidly spread to the upper floors of the mansion by means of a spiral wood stairway between the grand hall and the drawing room. The first alarm transmitted by telephone at 1:32 A.M. was followed by two additional alarms before 2:00 A.M., as the fire was unusually difficult to handle. The fire was not brought under control for three hours.

The 35-room, three-story and basement, stone walled mansion was built 25 years ago in the English idiom. Floors were wood joist and the interior finish metal lath and plaster on wood studs, except for wood wall bookcases and paneling, with plywood backing. Built into the structure were original hand-carved woodwork and panels imported from the London home of



Harris-Ewing.

Delayed discovery and distance to fire hydrants were responsible for the largest residential fire loss in the history of Washington, D. C. The valuable art collection and mansion owned by Col. R. M. Guggenheim were partially destroyed on January 31, 1946.



Harris-Ewing.

All that was left of the priceless 16th Century painting "The Village Feast" following a fire at the Guggenheim mansion in Washington, D. C., January 31, 1946.

Sir Christopher Wren, architect for St. Paul's Cathedral and other famous English buildings. Furnishings damaged in the fire included imported authentic French period furniture, drapes and tapestries. The damage to the building, particularly one of the wings, the upper floors and roof, was extensive but not total.

Several paintings of Col. Guggenheim's collection of priceless and irreplaceable art objects, collected over many years, were destroyed, many severely damaged. A 16th century painting by David Terriers, "The Village Feast" (see illustration) was damaged beyond repair. Two Titian paintings, "The Falconer" and "Lavinia," were fire-blackened. Two small Panini oils and a family portrait were lost in the fire as servants removed much of the highly valuable contents of the mansion to a near-by gardener's cottage. Van Dyck's "Earl of Arundel" and Murillo's "Salvator Mundi" miraculously escaped damage. A collection of rare Venetian glass also escaped destruction.

It is reported that Washington firemen conduct frequent drills in the sections of the city in which large estates with winding drives are found, but no fire department can be expected to operate effectively on such a fire without adequate water supplies, particularly where there is no automatic alarm system or other means of prompt discovery.

Fire Record of Cities, 1945.

Fire Department Reports.

Fire departments of 485 United States and 47 Canadian cities of over 20,000 population have reported their estimates of fire loss, fire alarms, building fires, and false alarms for the year 1945 to the N.F.P.A. Department of Fire Record.

In addition to the 1945 fire records of individual cities, this survey provides a good indication of the fire experience of the United States and Canadian cities as a whole. A total of 485 U. S. Cities having more than 20,000 population reported a fire loss for the year 1945 of $141,803,-174, amounting to an average loss per person of $2.66 for the 53,216,015 inhabitants of this group of cities. This may be compared with the per capita fire loss of $2.56 for a group of cities over 20,000 population reporting 1944 fire losses.

Forty-seven Canadian cities having a total population of 3,571,305 reported a total loss of $12,276,436 for 1945. This was a per person loss of $3.42, as compared with $3.24 for Canadian cities in 1944.

A total of 469 U. S. cities reported both loss data and the number of building fires. The average loss per building fire in these cities for 1945 was $640, as compared with $610 in 1944. The average loss per building fire for 47 Canadian cities was $565 in 1945, as compared with $723 in 1944.

The total number of building fires reported by 474 U. S. cities was 222,839, an average of 4.11 fires per 1000 population, as compared with 4.20 building fires per 1000 population in 1944 and 4.64 in 1943. Forty-nine Canadian cities reported 25,711 building fires in 1945. The number of building fires per 1000 population was 5.20 in 1945, as compared with 4.49 in 1944.

Fire departments in 485 U. S. cities of more than 20,000 population answered 630,220 alarms in 1945. The number of alarms answered by the fire departments in 49 Canadian cities was 46,780.

The number of malicious false alarms received by each department also has been added to the tables, with indication of the percentage such calls represent of the total number of alarms answered. In the United States, 471 cities of over 20,000 population reported 73,489 false alarms in 1945. This was 11.9% of the total calls answered by these cities. It will be noted that these are "malicious false alarms" and not just cases where smoke or steam, etc., was honestly mistaken for fire. This is a most regrettable waste of fire protection facilities. Forty-three Canadian cities reported 7,498 malicious false alarms, or 16.5% of their total calls. The increase in false alarms, particularly in a number of the larger cities, obviously reflects the enthusiasm with which V-J Day was received.

It is realized that populations of many cities have fluctuated greatly since the 1940 census. However, to keep the data as nearly comparable as possible, we have continued to use the 1940 U. S. Census figures for the U. S. cities, except in a limited number of cases where the Census Bureau has issued more recent official estimates, showing population changes.

The N.F.P.A. Department of Fire Record is indebted to a number of our members who were instrumental in helping to assemble these data in time for inclusion in the QUARTERLY. Fire departments have

been very co-operative in furnishing fire loss figures or giving us estimates where the final figures were not yet available. In very few cases fire departments indicated that it was not possible for them to supply the fire loss information.

It should be pointed out that in a number of cases these are preliminary loss estimates and may be subject to upward revision when end of year fire losses are adjusted. Experience in recent months has shown that fire department estimates of loss based upon normal loss estimating procedures may be considerably less than present day values that are being reflected in adjusted fire loss payments. Further, many fire departments do not record indirect losses such as use and occupancy and rent losses. In a number of large fires insurance payments on these indirect losses have exceeded the direct fire damage to buildings and contents.

While it must be admitted that these are occasional discrepancies in the manner in which certain cities report their fire losses, our questionnaire calls for the total fire loss, both insured and uninsured, and this is the figure given unless otherwise indicated. A few cities obviously do not give a complete record of their losses, but on the whole it is believed that these figures give a reliable indication of the relative trends in city fire losses in the United States and Canada. The number of chimney and roof fires has been included in the number of building fires. However, differences in methods of determining fire losses and differentiating between alarms and building fires should be considered to avoid unfair comparisons between cities.

It is suggested that these tables should not be used in making indiscriminate comparisons between cities. Fire losses reflect the composite results of many different factors in addition to fire department efficiency. Some cities have high losses due primarily to unfavorable structural conditions and unusual hazards, despite efficient fire departments.

During the war period ending during the year 1945, practically all fire departments operated under a handicap of inadequate manpower and lack of regular replacements of old apparatus.

1945 Fire Losses, Cities of 20,000 Population or Over.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
ALABAMA								
Anniston	25,523	....	....	....	....	....	....	....
Bessemer	22,826	$19,567	225	113	5.0	$1.64	2	0.9
Birmingham	267,583	506,068b	3,003	1,089	4.1	2.33	310	10.3
Gadsden	36,975	60,160	405	198	5.4	1.02	15	3.7
Mobile	106,727	300,228	1,248	760	7.2	1.80 (4)	95	7.7
Montgomery	78,084	100,308	677	386	5.0	1.65	58	8.6
Tuscaloosa	27,493	28,964	225	85	3.1	2.02	3	1.3
ARIZONA								
Phoenix	65,414	201,638	866	385	5.9	1.87	102	11.8
Tucson	36,818	77,318	515	161	4.4	3.68	143	27.8
ARKANSAS								
Fort Smith	36,584	52,159	715	188	5.2	5.27	36	5.0
Hot Springs	21,370	47,373	238	131	6.2	2.12 (4)	2	8.4
Little Rock	88,039	308,082	1,317	574	6.5	3.00	37	2.8
North Little Rock	21,137	139,325	514	134	6.4	4.95	10	1.9
Pine Bluff	21,290	146,669	505	229	10.8	4.31	6	1.2

(b) Subject to change. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
CALIFORNIA								
Alameda	89,906	52,590	662	201	2.2	0.49	56	8.5
Alhambra	38,935	....	....	....	....	....	....	....
Bakersfield	29,252	72,932	574	100	3.4	5.42	9	1.6
Belvedere Twp.	37,192	....	....	....	....	....	....	....
Berkeley	103,315	129,578	1,690	443	4.3	1.25	104	6.2
Beverly Hills	28,217	32,694	220	99	3.5	1.75	30	13.7
Burbank	53,899	92,846	617	180	3.4	1.38	14	2.3
Compton	23,460	....	292	38	1.6	....	6	2.0
Coronado	25,382	9,982	148	39	1.5	3.94 (1)	20	1.3
Fresno	63,672	276,604	600	202	3.2	2.64	81	13.5
Glendale	90,723	226,295	699	177	1.9	1.39	81	11.6
Huntington Park	28,648	108,816	193	84	2.9	2.32	7	3.6
Inglewood	37,912	171,154	396	110	2.9	3.02	7	1.8
Long Beach	219,624	166,818	2,575	515	2.4	0.70	76	3.0
Los Angeles	1,690,547	....	23,539	6,695	4.0	....	2,196	9.3
Oakland	372,921	999,188	4,882	1,338	3.6	4.36	911	18.7
Pasadena	84,054	91,432	962	174	2.1	1.20	117	12.2
Pomona	23,539	235,624	306	86	3.7	5.59	1	0.3
Richmond	93,738	109,051	994	149	1.6	1.62	150	15.1
Riverside	34,696	41,508	529	156	4.5	1.02	45	8.5
Sacramento	105,958	400,000a	1,546	580	5.5	3.24 (4)	229	14.9
San Bernardino	43,646	112,549	832	205	4.7	2.38	34	4.1
San Diego	401,860	300,000a	4,065	956	2.4	0.77	227	5.6
San Francisco	827,400	....	13,728	4,107	5.0	....	2,841	20.8
San Jose	68,457	177,122	647	363	5.3	1.58	60	9.3
San Leandro	22,903	29,695	217	98	4.3	1.30 (1)	3	1.4
San Mateo	26,804	34,759	410	53	2.0	1.30 (1)	17	4.1
Santa Ana	38,015	27,613	351	114	3.0	0.88	11	3.1
Santa Barbara	34,958	113,975	457	124	3.6	1.72	41	9.0
Santa Monica	57,596	49,831	861	195	3.4	0.67	71	8.3
South Gate	46,000	62,877	417	95	2.1	1.33	10	2.5
Stockton	58,865	250,000b	1,309	283	4.8	3.01	71	5.5
Vallejo	20,072	....	....	....	....	....	....	....
COLORADO								
Colorado Springs	36,789	24,975	498	233	6.4	0.74	21	4.2
Denver	322,412	595,670	3,650	1,643	5.1	1.77 (4)	400	11.0
Pueblo	52,162	136,543	902	381	7.3	1.05	55	6.1
CONNECTICUT								
Bridgeport	147,121	335,000a	1,059	531	3.6	3.27	65	6.1
Bristol	30,167	43,838	302	111	3.7	2.03	7	2.3
Danbury	22,339	56,414	220	207	9.3	2.52	14	6.4
Greenwich	35,509	95,736	452	126	3.6	3.41	8	1.8
Hartford	166,267	244,762	1,652	424	1.9	1.46	108	6.5
Meriden	39,494	83,875	330	143	3.6	2.83	18	5.5
Middletown	26,495	21,272	167	81	3.1	2.81	5	3.0
New Britain	68,685	65,559	513	157	2.3	2.91	20	3.9
New Haven	160,605	560,100	2,144	821	5.1	3.67	152	7.1
New London	30,456	32,772	566	209	6.9	2.44	26	4.6
Norwalk	39,849	111,711	586	213	5.4	1.92	11	1.9
Norwich	23,652	19,762a	303	191	8.1	1.50	14	4.6
Stamford	47,938	128,567	572	102	2.1	3.17	56	9.8
Stratford	22,580	28,720	367	127	5.6	2.62	....	....
Torrington	26,988	51,959a	249	104	3.9	0.89	18	7.2
Waterbury	99,314	148,173	1,588	415	4.2	2.74	96	6.1
West Hartford	33,776	33,377	320	168	5.0	1.41	1	0.3
West Haven Twp.	30,021	....	....	....	....	....	....	....

(a) Estimated. (b) Subject to change. (1) One-year only. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
DELAWARE								
Wilmington	111,432	201,757	1,068	612	5.5	1.63	39	3.8
DISTRICT OF COLUMBIA								
Washington	833,720	1,462,790	8,320	2,734	3.3	1.14	1,314	15.8
FLORIDA								
Daytona Beach	22,584	201,106	386	137	6.1	2.82	6	1.6
Jacksonville	183,065	600,000a	2,533	817	4.7	3.19	153	6.1
Lakeland	22,068	13,470	280	87	4.0	0.69 (4)	27	9.7
Miami	172,172	763,004	4,594	481	2.8	2.18	1,975	4.3
Miami Beach	28,012	....	....	....	....	....	....	....
Orlando	36,736	83,713	686	62	1.7	1.34	57	8.3
Pensacola	37,449	215,000	652	530	14.2	3.57 (2)	50	7.7
St. Petersburg	60,812	101,124	1,647	179	2.9	1.86	12	0.7
Tampa	108,391	319,561b	1,390	400	3.7	2.35	188	13.5
West Palm Beach	33,693	59,953	394	149	4.4	1.44	3	0.8
GEORGIA								
Athens	20,650	52,132	266	97	4.7	1.24	9	3.4
Atlanta	302,288	425,195	4,605	2,159	7.1	1.19	377	8.2
Augusta	65,919	297,910	938	281	4.3	2.66	28	3.0
Columbus	53,280	18,447a	566	284	5.3	1.45 (3)	65	11.5
La Grange	21,983	20,720	229	....	....	1.88	....	....
Macon	57,865	97,403	563	310	5.4	2.94	33	5.3
Rome	26,282	85,604	381	246	9.8	1.61	11	2.9
Savannah	95,996	180,113	1,314	621	6.5	1.32	162	12.4
IDAHO								
Boise	26,130	86,461	346	207	7.9	2.70	11	3.2
ILLINOIS								
Alton	31,255	40,634	378	147	4.7	2.22	6	1.6
Aurora	47,170	61,878	443	206	4.4	1.50	18	4.2
Belleville	28,405	112,175	328	96	3.4	1.52	3	0.9
Berwyn	48,451	21,190	168	96	2.0	3.67	6	3.6
Bloomington	32,868	22,865b	302	130	4.0	2.37	17	5.6
Champaign	23,302	20,140	240	178	7.6	1.52	6	2.6
Chicago	3,396,808	6,875,000a	33,566	10,229	3.0	1.74 (4)	2,521	7.5
Chicago Heights	22,461	51,119	228	103	4.6	3.55	34	15.0
Cicero	64,712	17,890	693	183	2.8	1.00	123	17.8
Danville	36,919	351,954	451	268	7.3	5.27 (4)	11	2.4
Decatur	59,305	141,144	705	362	6.1	1.73	26	3.7
East St. Louis	75,609	104,680	1,157	328	4.3	1.24	109	9.5
Elgin	38,333	107,955	287	227	5.9	1.56	1	0.3
Evanston	65,389	40,249	606	228	3.5	0.87	38	6.3
Freeport	22,366	10,606	253	62	2.8	3.14	14	5.5
Galesburg	28,876	321,703	331	227	7.9	6.12	3	0.9
Granite City	22,974	111,425	207	143	6.2	2.45	2	1.0
Joliet	42,365	310,976	585	365	8.6	4.33	107	18.3
Kankakee	22,241	44,157	185	69	3.1	1.26	11	6.0
Maywood	26,648	65,919	203	99	3.7	1.09	8	3.9
Moline	34,608	82,878	342	55	1.6	1.37	27	7.9
Oak Park	66,015	44,738	777	237	3.6	0.45	9	1.2
Peoria	105,087	101,803	1,319	680	6.5	2.57	121	9.2
Quincy	40,469	19,753	539	262	6.5	0.97	15	2.8
Rockford	84,637	100,230	1,199	506	6.0	1.70	85	7.2
Rock Island	42,775	87,246	472	274	6.4	2.41	37	7.8
Springfield	75,503	337,284	888	307	4.1	2.78	8	0.9
Waukegan	34,241	43,761	575	263	7.7	3.58	28	4.9

(a) Estimated. (b) Subject to change. (2) Two-year average. (3) Three-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
INDIANA								
Anderson	41,572	149,255	681	329	7.9	2.26	72	10.6
Bloomington	20,870	16,700	343	121	5.8	1.24	14	4.1
East Chicago	54,637	281,782	665	202	3.7	4.50	105	15.8
Elkhart	33,434	71,085	626	355	10.6	2.27	44	7.0
Evansville	97,062	407,148	1,385	495	5.1	2.50 (4)	259	18.8
Fort Wayne	118,410	225,600	1,568	536	4.6	0.96 (4)	351	2.3
Gary	111,719	275,330	1,328	772	7.0	1.08	73	5.5
Hammond	70,184	716,720	666	358	5.1	4.02	38	5.8
Indianapolis	386,972	1,368,314	4,072	2,026	5.3	2.18	450	11.1
Kokomo	33,795	79,491	468	260	7.7	1.98	50	10.7
Lafayette	28,798	245,310	398	....	....	2.52	31	7.9
Logansport	20,177	4,460	386	192	9.5	1.15	36	9.3
Marion	26,767	3,665,125	448	247	9.2	3.28	47	10.5
Michigan City	26,476	159,562	427	203	7.2	1.87	9	2.1
Mishawaka	28,298	23,586	293	137	4.9	0.97	56	19.2
Muncie	49,720	483,199	740	379	7.6	3.61	56	7.6
New Albany	25,414	58,439	444	355	14.0	1.60	46	10.4
Richmond	35,147	32,980	428	245	7.0	2.57	25	5.8
South Bend	101,268	403,000	1,295	554	5.5	2.77	167	13.0
Terre Haute	62,693	79,500	775	178	2.8	1.67	65	8.4
IOWA								
Burlington	25,832	113,945	509	115	4.5	3.19	39	7.7
Cedar Rapids	62,120	50,782	601	327	5.3	2.07	43	7.2
Clinton	26,270	....	....	....	....	....	....	....
Council Bluffs	41,439	68,040	647	284	6.9	1.27	40	6.2
Davenport	66,039	63,319b	744	153	2.3	1.20	110	14.8
Des Moines	159,819	632,662	2,116	744	4.7	2.74	100	4.7
Dubuque	43,892	34,671	766	335	7.7	3.12	51	6.7
Fort Dodge	22,904	98,302	304	119	5.2	2.22	15	4.9
Mason City	27,080	20,886	330	112	4.2	1.01	1	0.4
Ottumwa	31,570	106,376	497	264	8.4	2.77	....	....
Sioux City	82,364	183,309	1,218	664	8.1	1.62	123	10.2
Waterloo	51,743	92,801	572	262	5.1	2.06	133	23.3
KANSAS								
Hutchinson	30,013	46,304	613	177	5.9	0.97	25	4.1
Kansas City	121,458	132,412	1,947	695	5.7	1.09	....	....
Salina	21,073	249,916	451	....	....	4.77	....	....
Topeka	67,833	109,961a	977	343	5.1	1.21	84	8.6
Wichita	114,966	134,736	1,904	552	4.9	1.68	45	2.4
KENTUCKY								
Ashland	29,537	33,738	237	121	4.1	1.14 (4)	14	5.9
Covington	62,018	16,473	391	190	3.1	1.34	35	9.0
Lexington	49,304	122,323	600	354	7.2	3.12	11	1.8
Louisville	319,077	548,788	3,325	1,671	5.2	1.33	314	9.5
Newport	30,631	32,572	279	197	6.4	0.94	21	7.5
Owensboro	30,245	26,280a	490	192	6.4	1.34 (4)	7	1.4
Paducah	33,765	43,390	556	304	9.0	1.96	25	4.5
LOUISIANA								
Alexandria	27,066	64,690	339	164	6.1	2.56	74	21.8
Baton Rouge	34,719	31,181	355	272	7.9	1.29	67	18.9
Lake Charles	21,207	....	....	....	....	....	....	....
Monroe	28,309	....	....	....	....	....	....	....
New Orleans	494,537	682,361a	3,262	1,373	2.8	1.81	232	7.1
Shreveport	98,167	350,000	1,120	370	3.8	3.16	204	18.2

(a) Estimated. (b) Subject to change. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
MAINE								
Bangor	29,822	182,072	735	572	19.2	3.57	54	7.4
Lewiston	38,598	241,306	774	384	10.0	2.83	7	0.9
Portland	73,643	263,589a	1,470	296	4.0	2.61	145	9.8
MARYLAND								
Baltimore	859,100	3,544,417	9,022	4,123	4.8	2.91	643	7.1
Cumberland	39,483	49,500	333	185	4.6	2.73	57	17.1
Hagerstown	32,491	....	....	....	....	....	....	....
MASSACHUSETTS								
Arlington	40,013	49,985	767	....	....	1.09	47	6.1
Attleboro	22,071	159,259	423	61	2.8	4.96	11	2.6
Belmont	26,857	42,527	462	134	5.0	1.39	20	4.3
Beverly	25,537	....	852	....	....	....	8	0.8
Boston	770,816	3,074,499	13,704	....	....	4.23	2,357	17.2
Brockton	62,343	209,418	1,588	239	3.8	3.60	69	4.4
Brookline	56,940	92,728	1,023	565	10.0	1.82 (4)	36	3.5
Cambridge	110,879	311,053	2,195	910	8.3	2.69	318	14.5
Chelsea	41,259	180,000	1,025	21	0.5	4.40	25	2.4
Chicopee	41,664	68,478	583	160	3.9	2.00	56	9.6
Everett	46,784	197,000	947	166	3.5	2.93	87	9.2
Fall River	115,428	64,964	1,207	395	3.4	2.62	91	7.6
Fitchburg	41,824	151,473	720	233	5.6	2.79	59	8.2
Framingham	23,214	347,232	601	148	6.4	4.98	55	9.2
Gardner	20,206	58,737	293	208	10.3	2.90	15	5.1
Gloucester	24,046	87,778	728	128	5.3	5.20	32	4.4
Haverhill	46,752	286,802	1,159	347	7.4	4.75	8	0.7
Holyoke	53,750	210,951	861	710	13.2	4.33	46	5.3
Lawrence	84,323	158,964a	1,161	277	3.3	2.80	85	7.3
Leominster	22,226	39,409	400	152	6.9	2.54	13	3.3
Lowell	101,389	219,299	1,630	427	4.2	2.18	59	3.6
Lynn	98,123	275,053a	2,476	619	6.3	3.25	407	16.5
Malden	58,010	151,000	999	245	4.2	2.66	16	1.6
Medford	63,083	325,000a	1,399	173	2.7	2.32	61	4.4
Melrose	25,333	25,911	601	44	1.7	1.64	13	2.2
Methuen	21,880	37,773	427	56	2.6	1.69	8	1.9
New Bedford	110,341	188,051	998	425	3.9	1.85	79	7.9
Newton	69,873	102,584	1,351	151	2.2	1.33	93	6.8
North Adams	22,213	35,734a	278	....	....	1.23 (4)	7	2.5
Northampton	24,794	130,313a	340	240	9.7	3.87	5	1.5
Peabody	21,711	106,286	482	147	6.8	3.82	28	5.8
Pittsfield	49,684	97,096b	583	127	3.6	2.22	63	10.8
Quincy	75,810	330,657	1,641	362	4.8	3.88	160	9.7
Revere	34,405	102,267	877	128	3.7	2.02	171	19.5
Salem	41,213	133,781	868	235	5.7	3.01	58	6.7
Somerville	102,177	217,638	2,021	262	2.6	1.95	400	19.8
Springfield	149,554	650,000a	2,358	571	3.8	3.90	306	13.0
Taunton	37,395	53,160	684	221	5.9	3.36	70	10.2
Waltham	40,020	104,281	1,028	163	4.1	3.11	80	7.9
Watertown	35,427	55,361	594	194	5.8	1.96	23	3.9
Weymouth	23,868	75,381	460	396	9.3	2.60	19	4.1
Worcester	193,694	439,459	4,731	1,441	7.5	2.71	476	10.1
MICHIGAN								
Ann Arbor	29,815	100,798	460	88	3.0	2.90	4	0.9
Battle Creek	43,453	366,060	825	209	4.8	3.18	....	....
Bay City	47,956	117,260	873	145	3.0	2.75	33	3.8
Dearborn	72,985	164,167	738	239	3.3	6.20	128	17.4
Detroit	1,654,972	5,032,667a	16,769	6,805	4.2	2.44	2,943	17.6

(a) Estimated. (b) Subject to change. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
Ferndale	22,523	55,248	330	143	6.4	1.81	53	16.0
Flint	151,543	365,118	1,661	1,283	8.5	1.76	352	21.2
Grand Rapids	164,292	405,677	1,567	379	2.3	2.64	127	8.1
Hamtramck	52,470	91,576	481	293	5.6	2.58	142	29.5
Highland Park	50,810	210,127	553	187	3.7	1.90	50	9.1
Jackson	49,656	36,544	713	445	9.0	2.86	43	6.0
Kalamazoo	54,097	537,483	742	223	4.1	3.78	35	4.7
Lansing	78,753	496,805	1,577	436	5.5	2.98	148	9.4
Muskegon	50,215	374,155	593	115	2.3	4.07	82	13.8
Pontiac	65,945	248,628	779	431	6.7	3.98	120	15.4
Port Huron	32,759	139,386a	622	416	12.7	3.60	35	5.6
Royal Oak	25,087	73,548	474	126	5.0	2.10 (3)	65	13.7
Saginaw	82,794	135,870	1,017	327	4.0	2.64	61	6.0
Wyandotte	30,618	64,314	439	169	5.5	4.71	42	9.7
MINNESOTA								
Duluth	101,065	128,071	1,235	834	8.3	2.68	78	6.3
Minneapolis	492,370	2,397,982	3,848	944	1.9	2.75	149	3.9
Rochester	26,312	12,000a	318	127	4.8	1.60	51	16.0
St. Cloud	24,173	89,095	268	70	2.9	2.73	19	7.1
St. Paul	287,736	950,000a	3,363	940	3.3	2.21	247	7.4
Winona	22,490	200,104	298	213	9.3	3.79	12	4.0
MISSISSIPPI								
Greenville	20,892	22,085	242	151	7.3	1.66	5	2.1
Hattiesburg	21,026	148,920	456	97	4.6	2.64	16	3.5
Jackson	62,107	305,011	796	309	5.0	2.49	83	10.4
Laurel	20,598	25,442	189	116	5.7	1.87 (4)	15	8.0
Meridian	35,481	118,378	626	260	7.4	3.24	48	7.7
Vicksburg	24,460	7,850	341	54	2.2	0.84	20	5.9
MISSOURI								
Hannibal	20,865	86,040	248	125	6.0	1.39	5	2.0
Jefferson City	24,268	2,955	345	130	5.4	0.60	5	1.5
Joplin	37,144	140,000	870	392	10.6	1.33	14	1.6
Kansas City	399,178	855,193	5,868	2,173	5.4	2.55	635	10.8
St. Joseph	75,711	161,049a	1,101	246	3.3	1.33	32	2.9
St. Louis	822,630	1,268,761c	5,899	2,392	3.9	1.02	824	14.0
Sedalia	20,428	41,415	307	200	9.8	1.90	4	1.3
Springfield	61,238	561,023	1,065	537	8.8	3.00	98	9.3
University City	33,023	20,635	819	87	2.6	0.52	11	1.4
MONTANA								
Billings	23,261	126,587	237	106	4.6	5.91	44	1.9
Butte	37,081	53,791	404	139	3.8	1.33	120	3.0
Great Falls	29,928	16,474	364	39	1.3	2.81	24	6.7
NEBRASKA								
Lincoln	81,984	91,699b	1,043	430	5.3	1.63	17	1.6
Omaha	223,844	500,000a	3,061	1,215	5.4	1.88	97	3.2
NEVADA								
Reno	21,317	126,310	718	391	18.5	3.48	47	6.6
NEW HAMPSHIRE								
Concord	27,171	74,456	498	241	8.9	2.54	7	1.4
Manchester	77,685	....	1,004	318	4.1	....	51	5.1
Nashua	32,927	166,328	553	334	10.1	4.60	16	2.9
NEW JERSEY								
Atlantic City	64,094	427,025	728	351	5.5	6.94	68	9.4
Bayonne	79,198	88,232	827	711	9.0	1.08	103	12.5

(a) Estimated. (b) Subject to change. (c) From April 1, 1945 to Dec. 31, 1945. (3) Three-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
Belleville	28,167	18,500	299	52	1.9	1.35	31	10.4
Bloomfield	41,623	22,110	467	136	3.3	0.73	21	4.5
Camden	117,536	296,247	1,160	442	3.8	2.02	26	2.2
Clifton	48,827	945,701	531	65	1.3	5.48	48	9.1
East Orange	68,945	101,161	558	224	3.3	1.00	54	10.6
Elizabeth	109,912	68,090	734	319	2.9	2.34	73	10.0
Garfield	28,044	26,390	58	31	1.1	0.47	....	....
Hackensack	26,279	166,595	351	114	4.4	2.03	7	2.0
Hoboken	50,115	241,097	513	440	8.8	3.26	63	12.3
Irvington	55,328	68,000	340	130	2.4	1.10	29	8.5
Jersey City	301,173	389,015	2,405	1,246	4.1	2.39	330	13.8
Kearny	39,467	481,680	336	78	2.0	31.10	20	6.0
Linden	24,115	32,858	362	125	5.2	1.14 (4)	24	6.6
Maplewood	23,139	6,087	217	106	4.6	0.51	17	7.8
Montclair	39,807	39,853	428	175	4.4	1.28	8	0.2
Newark	429,760	1,989,061	4,210	1,834	4.3	2.86	26	6.2
New Brunswick	33,180	134,914	426	148	4.5	2.94	43	10.1
North Bergen Twp.	39,714	15,026	647	85	2.1	0.48 (4)	16	2.5
Nutley	21,954	17,640	400	50	2.3	1.63 (4)	26	6.5
Orange	35,717	138,918	309	102	2.9	2.01	48	15.5
Passaic	61,394	233,099	582	210	3.4	5.00	51	8.8
Paterson	139,656	377,252	1,156	746	5.4	2.44	79	6.9
Perth Amboy	42,242	17,870	123	49	1.2	0.58	18	14.6
Plainfield	37,469	251,810	516	175	4.7	4.10 (4)	21	4.1
Teaneck Twp.	25,275	30,499	539	121	4.8	1.02	13	2.4
Trenton	124,697	137,108	1,058	519	4.2	1.67	78	7.4
Union City	56,173	67,134	980	150	2.7	1.79	40	7.1
Union Twp.	24,730	8,355	346	39	1.6	1.55	4	1.2
West New York	39,439	55,302	517	108	3.7	1.09	40	7.7
West Orange	25,662	38,761	227	60	2.3	0.57 (4)	8	3.5
Woodbridge	27,191	106,190	....	39	1.5	4.33 (2)	....	....
NEW MEXICO								
Albuquerque	35,449	....	....	....	....	....	....	....
Santa Fe	20,325	17,000	89	59	2.9	0.73	....	....
NEW YORK								
Albany	130,577	343,120	2,118	1,006	7.7	1.69	409	19.4
Amsterdam	33,329	52,064	379	138	4.2	3.24	10	2.5
Auburn	35,753	....	356	172	4.8	....	....	....
Binghamton	78,309	206,293a	617	255	3.3	3.24	24	3.9
Buffalo	575,901	1,182,946a	5,038	1,357	2.3	1.75	369	7.3
Cohoes	21,955	....	....	....	....	....	....	....
Elmira	45,106	63,722	381	201	4.5	1.59	23	6.1
Freeport	20,400	283,905	215	67	3.3	1.39 (1)	38	17.6
Gloversville	23,329	52,478	293	89	3.8	1.86	15	5.1
Hempstead	20,856	90,109	266	64	3.1	2.64 (4)	42	15.8
Jamestown	42,638	59,716	444	163	3.8	2.60	24	5.4
Kingston	28,589	51,717	371	153	5.4	1.13	7	1.9
Lackawanna	24,058	32,645	305	48	2.0	1.83 (4)	62	20.3
Lockport	24,379	75,890	311	....	....	3.51 (2)	....	....
Middletown	21,908	....	....	....	....	....	....	....
Mount Vernon	67,362	62,986	551	192	2.8	1.30	58	10.5
New Rochelle	58,408	122,826	442	183	3.1	1.51	7	1.6
New York	7,454,995	14,765,700	50,281	19,870	2.7	1.44	16,871	33.4
Niagara Falls	78,029	69,123	753	245	3.1	1.19	248	33.0
North Tonawanda	20,254	81,287	154	88	4.4	3.98	10	6.5
Newburgh	31,883	118,489	218	122	3.8	2.57	9	4.1
Olean	21,506	17,289	195	68	3.2	1.30	14	7.2
Oswego	22,062	130,684	230	102	4.6	5.96	27	11.7
Port Chester	23,073	....	....	....	....	....	....	....

(a) Estimated. (1) One-year average. (2) Two-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
Poughkeepsie	40,478	106,513	430	282	7.0	2.24	32	7.4
Rochester	324,975	578,131	2,969	881	2.7	1.40	221	7.5
Rome	34,214	69,386	338	139	4.1	2.50	26	7.2
Schenectady	87,549	78,945	1,123	265	3.0	1.91	81	7.2
Syracuse	205,967	1,055,886	1,791	625	3.0	2.76	335	18.7
Troy	70,304	145,412d	1,052	751	10.7	2.32	29	2.8
Utica	100,518	152,570	778	361	3.6	1.86	56	7.2
Watertown	33,385	62,215a	353	207	6.2	2.67	34	9.6
White Plains	40,327	52,324	381	82	2.0	0.88	23	6.0
Yonkers	142,598	251,169	1,392	660	4.6	1.54	132	9.5
NORTH CAROLINA								
Asheville	51,310	302,970	762	257	5.0	2.96	58	7.6
Burlington	21,830	....	....	....	....	....	....	....
Charlotte	100,899	304,630	1,768	833	8.3	2.74	170	9.7
Durham	60,195	85,933	728	353	5.9	1.98	50	6.9
Gastonia	21,313	79,485	253	104	4.9	2.22	34	13.4
Greensboro	59,319	140,731	847	223	3.8	2.16	138	16.3
High Point	38,495	147,357	439	158	4.1	5.20	30	6.8
Raleigh	46,897	45,987	748	611	13.0	1.89	137	18.3
Rocky Mount	25,568	31,839	258	116	4.6	0.82	6	2.3
Wilmington	33,407	62,037	515	334	10.0	2.52	52	10.1
Winston-Salem	79,815	829,299	767	153	1.9	2.86	34	4.4
NORTH DAKOTA								
Fargo	32,580	35,149	194	156	4.8	1.64	14	7.2
Grand Forks	20,228	34,785	208	102	5.0	7.90	7	3.4
OHIO								
Akron	244,791	852,489	2,416	755	3.1	1.99	353	14.6
Alliance	22,405	367,633	125	109	4.9	6.35	31	22.5
Ashtabula	21,405	29,165	224	100	4.7	2.12	2	0.9
Barberton	25,028	59,037	346	203	8.5	1.35	137	4.6
Canton	108,401	493,761	1,019	263	2.4	2.66	116	11.5
Chillicothe	20,129	12,818	222	33	1.6	0.59	7	3.2
Cincinnati	455,610	778,219a	4,986	1,883	4.1	1.96	443	8.9
Cleveland	878,336	2,973,405a	8,348	2,782	3.2	4.72	838	10.1
Cleveland Heights	58,000	34,420	605	89	1.5	0.47	12	2.0
Columbus	306,087	1,164,825	7,356	2,001	6.5	1.60	216	2.9
Cuyahoga Falls	20,546	28,373	226	43	2.1	0.74	20	8.8
Dayton	210,718	387,902	2,527	760	3.6	2.37	395	15.7
East Cleveland	39,495	22,813	392	94	2.4	0.70	20	6.8
East Liverpool	23,555	27,346	337	175	7.4	1.02 (3)	20	5.9
Elyria	25,120	56,262	198	99	3.9	2.89	2	1.0
Findlay	20,228	96,487	247	107	5.3	2.06	13	5.1
Hamilton	50,592	215,015	811	301	6.0	2.06	36	4.4
Lakewood	69,160	99,002	354	205	3.0	0.90	68	19.2
Lancaster	21,940	16,606	256	114	5.2	1.40	41	16.0
Lima	44,711	399,407	673	216	4.8	3.47	47	7.0
Lorain	44,125	34,886	437	132	3.0	1.20	28	6.4
Mansfield	37,154	169,381	442	227	6.1	5.25	44	10.0
Marion	30,817	33,545	324	192	6.2	1.37	30	9.3
Massillon	26,644	16,955	308	71	2.7	4.52	9	2.9
Middletown	31,220	56,591	363	180	5.8	2.13	35	9.6
Newark	31,487	69,579	375	214	6.8	1.55	18	4.8
Norwood	34,010	23,159	230	125	3.7	0.74	16	7.0
Portsmouth	40,466	22,400	342	184	4.6	1.41	42	12.3
Sandusky	24,874	29,617	536	186	7.5	3.49 (4)	14	2.7
Shaker Heights	23,393	26,118	320	105	4.5	1.26	18	5.6
Springfield	70,662	311,478	797	517	7.3	2.12	32	4.0

(a) Estimated. (d) Insurance. (3) Three-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
Steubenville	37,651	30,867	391	205	5.5	2.30	89	22.8
Toledo	282,349	549,380	2,813	1,101	3.9	2.02	460	16.4
Warren	42,837	79,624	400	183	4.3	1.05	34	8.5
Youngstown	167,720	294,099	1,377	424	2.5	1.20	345	2.5
Zanesville	37,500	137,589	371	168	4.5	1.88	41	11.0
OKLAHOMA								
Enid	28,081	86,526	508	256	9.1	2.39	44	8.7
Muskogee	32,332	40,527	885	167	5.2	1.49	19	2.2
Oklahoma City	204,424	254,644	3,215	559	2.7	1.47	159	5.0
Shawnee	22,053	116,006	561	36	1.6	2.02	11	2.0
Tulsa	142,157	755,976b	2,564	611	4.3	1.79	144	5.6
OREGON								
Eugene	20,838	220,317	484	306	14.7	4.12 (4)	7 •	1.5
Portland	363,141	1,400,000a	4,868	3,353	9.2	4.11	313	6.0
Salem	30,908	350,782	460	350	11.3	4.90	11	2.4
PENNSYLVANIA								
Abington Twp.	20,857	....	....	....	....	....	....	....
Aliquippa	27,023	3,009	136	11	4.1	0.37	11	8.1
Allentown	96,904	28,265	275	101	1.0	0.48	34	12.4
Altoona	80,214	62,830	577	433	5.4	0.67	144	2.5
Bethlehem	58,490	13,126	189	108	1.9	1.72	6	3.2
Butler	24,477	51,600	157	108	4.4	2.81	....	....
Chester	59,285	....	....	....	....	....	....	....
Dunmore	23,086	7,965	68	26	1.1	0.93	42	62.0
Duquesne	20,693	....	....	....	....	....	....	....
Easton	33,589	47,830	175	99	3.0	2.95	12	6.9
Erie	116,955	532,880	1,034	552	4.8	2.41	115	9.9
Harrisburg	83,893	323,684	478	332	4.0	2.17	34	7.1
Haverford Twp.	27,594	....	....	....	....	....	....	....
Hazelton	38,009	137,676	114	60	1.6	2.94	7	6.1
Johnstown	66,668	47,605	648	322	4.8	0.67	81	12.5
Kingston	20,679	2,240	119	18	0.9	1.13	16	13.5
Lancaster	61,345	43,507	270	94	1.4	1.00	37	13.7
Lebanon	27,206	12,099	73	66	2.4	0.51	5	6.9
Lower Merion Twp.	39,566	65,606	545	127	3.2	3.62	2	0.4
McKeesport	55,355	524,259	446	237	4.3	3.10	56	12.6
Monessen	20,257	9,020	93	61	3.0	1.58 (3)	63	67.7
Nanticoke	24,387	....	....	....	....	....	....	....
New Castle	47,638	202,773	356	262	5.5	1.73	89	24.3
New Kensington	24,055	11,504	136	54	2.3	1.39 (4)	25	18.4
Norristown	38,181	22,494	118	65	1.7	1.24	2	1.7
Oil City	20,379	29,108	190	60	3.0	1.00 (4)	5	2.6
Philadelphia	1,931,334	5,908,229b	12,255	4,673	2.4	2.55	1,556	12.7
Pittsburgh	671,659	1,300,000a	5,040	2,603	3.9	1.31	923	18.3
Pottstown	20,194	25,007	19	15	0.7	2.82	6	3.2
Pottsville	24,530	79,659	81	53	2.2	1.72	....	....
Reading	110,568	151,402	403	265	2.4	1.29	27	6.7
Scranton	140,404	550,000a	785	250	1.8	2.38 (3)	132	16.8
Sharon	25,622	37,564	232	19	0.7	1.85	11	4.8
Uniontown	21,819	....	....	....	....	....	....	....
Upper Darby Twp.	56,883	....	....	....	....	....	....	....
Washington	26,166	33,166	315	136	5.4	0.83	16	5.1
Wilkes-Barre	86,236	125,888	505	221	2.6	1.75	88	17.5
Wilkinsburg	29,853	....	....	....	....	....	....	....
Williamsport	44,355	43,985	274	204	4.6	1.36	12	4.4
York	56,712	227,117	241	163	2.9	1.43	10	4.2

(a) Estimated. (b) Subject to change. (3) Three-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
RHODE ISLAND								
Central Falls	25,121	....	....	....	....	....	....	....
Cranston	47,173	49,318	791	146	3.1	1.33	68	8.6
East Providence	32,093	53,631	818	115	3.6	1.44	110	13.5
Newport	30,402	81,588	432	264	8.7	2.16	33	7.6
Pawtucket	75,449	126,721	1,277	307	4.1	2.39	204	16.0
Providence	253,214	573,447	4,079	820	3.2	1.90	541	13.3
Warwick Twp.	28,616	....	....	....	....	....	....	....
Woonsocket	49,204	410,727	582	168	3.4	3.53	45	7.7
SOUTH CAROLINA								
Charleston	81,347	....	....	....	....	....	....	....
Columbia	62,396	197,650	1,083	454	7.3	1.93	65	6.0
Greenville	34,734	84,897	457	279	8.0	4.71	14	3.0
Spartanburg	32,249	436,717	696	261	8.1	6.10	84	12.0
SOUTH DAKOTA								
Sioux Falls	40,832	37,953	468	147	3.6	1.55	25	5.3
TENNESSEE								
Chattanooga	128,163	421,722	1,614	611	4.8	2.14	131	8.1
Jackson	24,332	27,569	361	195	8.0	3.21	....	....
Johnson City	25,353	45,325	332	83	3.3	2.01	3	0.9
Knoxville	111,580	162,466	1,395	694	6.3	1.18 (4)	113	8.1
Memphis	292,942	811,340a	4,083	1,166	4.0	2.29	106	2.6
Nashville	167,402	360,398	2,953	925	5.5	3.16	376	12.8
TEXAS								
Abilene	26,612	105,000b	567	67	2.5	5.96	33	5.8
Amarillo	51,686	196,364	868	142	2.8	2.31	57	6.6
Austin	115,000	140,268	1,292	400	4.6	1.66	58	4.5
Beaumont	77,335	83,951a	878	686	8.9	2.42	37	4.2
Brownsville	22,083	10,855	144	61	2.8	0.69 (4)	5	3.5
Corpus Christi	57,301	248,122	885	134	2.3	2.98	99	11.2
Dallas	294,734	1,243,602	5,667	....	....	4.56	323	5.7
El Paso	96,810	200,000a	1,122	474	4.9	1.28 (4)	152	13.6
Fort Worth	177,662	1,211,568	4,356	1,506	8.5	3.48	313	7.2
Galveston	60,862	413,986	906	126	2.1	4.12	216	2.4
Houston	384,514	1,640,988	5,779	1,766	4.6	2.81	993	17.2
Laredo	39,274	28,182	320	129	3.3	0.72	6	1.9
Lubbock	31,853	88,000a	466	....	....	2.62	10	2.2
Port Arthur	46,140	49,472	368	70	1.5	0.99	54	14.7
San Angelo	25,802	50,514	418	179	6.9	2.13	47	11.3
San Antonio	253,854	1,293,677	3,270	978	3.9	1.90	201	6.1
Tyler	28,279	87,305	575	80	2.8	3.44	11	1.9
Waco	55,982	122,194	715	320	5.7	3.04	44	6.2
Wichita Falls	45,112	203,992	1,117	100	2.2	9.20	....	....
UTAH								
Ogden	43,688	63,884	795	201	4.6	1.68	50	6.3
Salt Lake City	149,934	234,872	1,533	665	4.5	3.05	84	5.5
VERMONT								
Burlington	27,686	....	490	327	11.8	....	25	5.1
VIRGINIA								
Alexandria	49,584	319,035	472	242	4.9	2.13 (4)	9	1.9
Danville	32,749	33,107	323	162	5.0	2.43	17	5.3
Lynchburg	44,541	71,599	660	283	6.4	3.16	56	8.5
Newport News	45,599	149,728	731	339	7.5	6.24	100	13.7
Norfolk	231,949	640,000	2,768	1,353	5.8	2.85	495	18.0

(a) Estimated. (b) Subject to change. (3) Three-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
Petersburg	30,631	108,796	480	156	5.1	2.08	37	7.7
Portsmouth	81,951	160,161	537	305	3.7	1.78	92	17.1
Richmond	222,818	219,534	3,192	1,654	7.4	1.02	234	7.3
Roanoke	69,287	146,866	672	341	4.9	2.03	73	10.9
WASHINGTON								
Bellingham	29,314	180,173	826	281	9.6	3.30	67	8.1
Everett	30,224	31,560	732	505	16.7	2.62	34	4.7
Seattle	434,204	760,000a	4,733	....	....	1.48	484	10.3
Spokane	122,001	607,899	1,611	788	6.5	2.85	134	8.3
Tacoma	129,302	551,715	2,622	1,338	10.3	2.71	205	7.8
Yakima	27,221	56,903	382	181	6.7	3.38	36	9.4
WEST VIRGINIA								
Bluefield	20,641	77,575	173	50	2.4	1.60	20	11.6
Charleston	67,914	....	....	....	....	....	....	....
Clarksburg	30,579	9,962	213	202	6.6	1.52	6	2.8
Fairmont	23,105	125,000	145	105	4.6	2.82 (2)	5	3.4
Huntington	78,836	389,012	993	318	4.0	3.74	132	13.3
Parkersburg	30,103	60,260	188	65	2.2	1.75	13	6.9
Wheeling	61,099	273,643	672	342	5.6	3.19	38	5.7
WISCONSIN								
Appleton	28,436	20,836	345	287	10.1	1.80	30	8.7
Beloit	25,365	23,663	428	221	8.7	1.15	83	2.0
Eau Claire	30,745	94,858	544	214	7.0	1.59	84	15.5
Fond du Lac	27,209	352,300	409	189	6.9	4.50	22	5.4
Green Bay	46,235	32,812	496	450	9.7	2.41	9	1.8
Janesville	22,992	15,955	403	179	7.8	4.10	29	7.2
Kenosha	48,765	125,886	844	316	6.5	1.77	15	1.8
La Crosse	42,707	120,673	217	378	8.9	3.82	39	1.8
Madison	67,447	55,257	869	325	4.8	0.88	57	6.6
Manitowoc	24,404	14,642b	394	212	8.7	1.58	29	7.4
Milwaukee	587,472	1,435,580	7,716	3,315	5.6	1.51	358	4.7
Oshkosh	39,089	126,617	398	242	6.2	2.54	28	7.0
Racine	67,195	106,169	1,007	300	4.5	1.48	52	5.2
Sheboygan	40,638	47,214	391	302	7.5	0.91	27	6.9
Superior	35,136	50,390	664	329	9.4	8.65	96	14.5
Wausau	27,268	30,195	496	296	10.9	1.04	24	4.9
Wauwatosa	27,769	26,800	284	78	2.8	0.73	5	1.8
West Allis	36,364	48,503	408	75	2.1	1.11	29	7.1
WYOMING								
Cheyenne	22,408	119,545	447	369	16.5	3.39 (4)	36	8.1
HAWAII								
Honolulu	200,158	482,323a	1,308	339	1.7	1.51	308	2.4

1945 Fire Losses, Canadian Cities.

ALBERTA								
Calgary	85,726	....	746	163	1.9	....	218	2.9
Edmonton	120,000	207,586	1,312	533	4.4	2.40	142	10.8
BRITISH COLUMBIA								
Burnaby	35,000	37,327	304	143	4.1	1.07 (1)	....	....
New Westminster	24,000	22,041	307	220	9.2	1.52	10	3.3
Saanich	25,000	13,968	266	107	4.3	0.56 (1)	5	1.9
Vancouver	360,000	2,608,826a	3,954	2,701	7.5	3.07	86	2.2
Victoria	53,000	99,178	855	384	7.3	1.21	119	14.0

(a) Estimated. (b) Subject to change. (1) One-year only. (2) Two-year average. (4) Four-year average.

City	Population	Total Loss 1945	No. Alarms 1945	No. Bldg. Fires 1945	Bldg. Fires per 1000 Population	5-Year Av. Loss per Person	No. Malicious False Alarms 1945	Per Cent of False Alarms 1945
MANITOBA								
Winnipeg	224,252	433,494	2,381	1,283	5.7	1.58	308	13.0
NEW BRUNSWICK								
Moncton	22,763	157,423	260	131	5.8	3.45	26	10.0
Saint John	51,741	134,544	929	732	14.2	9.19	93	10.0
NOVA SCOTIA								
Dartmouth	20,000	....	....	....	....	....	....	....
Glace Bay	25,000	30,000	107	58	2.3	1.34	....	....
Halifax	106,742	310,924	1,090	773	7.3	4.92	177	16.2
Sydney	35,000	121,372	426	312	8.7	3.15	1,174	26.9
ONTARIO*								
Brantford	34,848	35,315	390	83	2.4	1.19	12	3.1
East York Twp.	43,399	32,392	173	51	1.2	0.35	....	....
Fort William	29,103	102,592	506	76	2.6	2.76	10	2.0
Guelph	23,225	278,926	277	210	9.1	3.96	....	....
Hamilton	175,364	662,857	1,383	918	5.2	3.14	132	9.6
Kingston	33,296	173,193	531	311	9.4	2.98 (3)	94	17.7
Kitchener	36,797	77,679	245	106	3.3	2.46	4	0.2
London	81,158	186,357	600	230	2.8	0.99	3	0.5
North York Twp.	26,000	82,233	216	70	2.7	3.16 (1)	4	1.8
Oshawa	26,370	47,630	255	106	4.0	2.42	14	5.5
Ottawa	195,327	499,137	1,772	851	4.4	2.93	272	15.4
Peterboro	32,379	60,852	550	329	10.2	1.51	37	6.7
Port Arthur	25,000	705,331	592	390	15.6	7.00	11	1.9
St. Catharines	34,559	22,706	373	204	5.9	1.85	28	7.5
Sarnia	20,082	90,148	227	59	3.0	4.51 (1)	....	....
Sault Ste. Marie	28,813	15,071	238	43	1.5	2.22	23	9.7
Scarboro Twp.	24,142	58,149	270	63	2.6	1.97 (3)	49	18.2
Sudbury	35,812	162,108	456	275	7.7	1.90	17	3.7
Timmins	24,070	156,752	459	350	14.6	3.00	24	5.2
Toronto	745,626	2,086,216	5,461	3,456	4.6	2.69	647	11.9
Windsor	108,567	598,154	878	427	4.2	1.93	130	14.8
York Twp.	80,348	100,804	467	365	4.6	0.86 (2)	10	2.1
QUEBEC								
Chicoutimi	20,103	....	....	..	....	....	....	....
Hull	36,900	138,344	736	622	16.9	2.48	64	8.7
Jonquiere	21,500	9,118	62	62	2.9	0.43	....	....
Lachine	27,104	77,928	117	74	2.7	2.88	25	21.4
Montreal	1,320,000	....	8,580	3,875	2.9	....	2,433	2.8
Outremont	31,000	40,207	260	184	5.9	2.72	26	10.0
Quebec	176,386	1,000,000a	3,727	1,980	11.3	4.25	592	15.9
Shawinigan Falls	25,000	80,584	310	258	10.3	3.22 (1)	8	2.6
Sherbrooke	38,942	51,981	659	439	11.3	1.82	45	6.8
Three Rivers	45,000	155,201	613	506	11.2	2.02	12	19.6
Verdun	75,000	46,429	571	257	3.4	0.97	154	2.7
Westmount	26,000	47,823	281	77	3.0	1.70	37	13.2
SASKATCHEWAN								
Moose Jaw	20,000	23,028	327	154	7.7	0.91	48	14.7
Regina	60,000	91,000b	676	381	6.4	1.67	94	14.0
Saskatoon	41,690	135,036	605	329	7.9	1.73	82	13.6

(a) Estimated. (b) Subject to change. (1) One-year only. (2) Two-year average. (3) Three-year average.

*Fire losses from Ontario Fire Marshal.

Atlanta Journal.

Rubber still burns. This fire in the property of the Dixie Rubber Products Co., Atlanta, Feb. 25, 1946, caused an estimated loss of $350,000. A million scrap tires were stored in a one-acre pile, without any subdividing aisle spaces, and directly against buildings. The buildings, containing rubber cement and the flammable materials, had neither automatic sprinklers nor exposure protection from the scrap pile. The fire started from an unknown cause in the scrap. The noxious smoke of burning rubber hampered fire fighting, and the loss to the scrap pile and four buildings was total.

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The following additional separate parts, not included in the Index, have been mailed with issues of the Quarterly in this volume.

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No. 2, Part 2. Membership Directory "Year Book."
Part 3. Fires in Hospitals and Institutions.
No. 3, Part 2. School Fires.
No. 4, Part 2. Advance Reports to Fiftieth Annual Meeting.
Part 3. Electrical Committee Report — Proposed 1946 National Electrical Code.

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Wichita, Kansas, Hangar Fire, Sept. 26, 1945. (Photo)	2	72
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Willits, Calif., Sawmill Fire, Aug. 22, 1945	3	233
Windsor, Ont., Canada, Multiple Occupancy Fire, Dec. 24, 1945	3	201
Winston-Salem, N. C., Tobacco Whse. Fire, Nov. 6, 1945	3	174
Woonsocket, R. I., Warehouse Fire, May 27, 1945. (Photo)	1	6
	3	169

A delayed alarm caused this Chicago building, headquarters for four lumber companies, to be completely destroyed by fire on April 11, 1945. A strong wind and concealed spaces in the building construction made the automatic sprinkler system ineffective.

Twenty minutes after this fire was discovered someone telephoned the fire department. The fire fighters did their noble best but the alarm came too late for human efforts to save the building and its contents... the loss was more than $600,000.

The best insurance against delayed alarms, an outstanding cause of large-loss fires, is the automatic detection and reporting of fires in their incipiency. A.D.T. provides this protection through Aero Automatic Fire Alarm Service in unsprinklered properties and through Sprinkler Supervisory and Waterflow Alarm Service in sprinklered properties.

May we tell you how automatic protection can be employed to effect substantial economies while providing increased protection? Write for complete information and descriptive booklets.

A. D. T. ELECTRIC PROTECTION SERVICES

Controlled Companies of **AMERICAN DISTRICT TELEGRAPH CO.** *155 Sixth Ave., New York 13, N. Y.*

CENTRAL STATION OFFICES IN ALL PRINCIPAL CITIES OF THE U. S.

A·D·T

Electric Protection Services

AGAINST FIRE · BURGLARY · HOLDUP

A NATION-WIDE ORGANIZATION

UNDERWRITERS' APPROVED . . .

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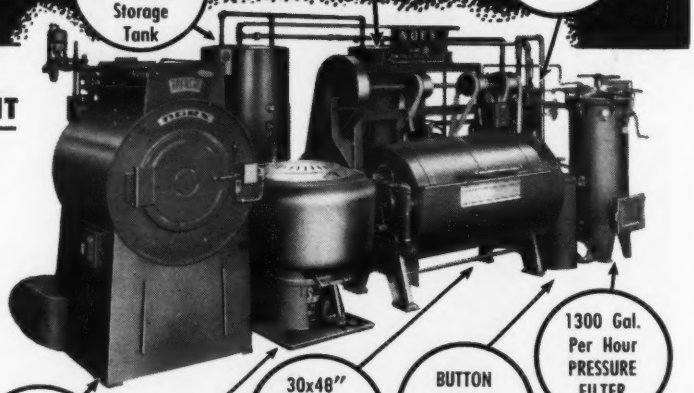
for use with . . .

140° FLASH PETROLEUM SOLVENT

- NOEX Dry Cleaning Unit has been approved by Underwriters' Laboratories as a Class II Unit *since 1942*.
- NOEX is designed to give *positive* safety protection with listed petroleum solvents having a flash point of 138.2°F., or over.
- NOEX is a quality product of the world's largest and oldest manufacturer of laundry and dry cleaning equipment.


135 Gal. Capacity Clean Solvent Storage Tank
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75 Gal. Per Hour VACUUM STILL
1300 Gal. Per Hour PRESSURE FILTER
BUTTON and VACUUM TRAP
30x48" BUCKEYE All-Metal Washer
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The AMERICAN LAUNDRY MACHINERY COMPANY

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Yours for the asking is a fully illustrated, quick-reference catalog that will give you complete information on dependably safe NOEX. Write today.

Consider these questions for a moment: If you have vaults for filing tracings, blue prints or other valuable records; storage spaces where highly flammable liquids and chemicals are kept; bake ovens, dip tanks, spray booths, and electrical equipment—and a serious fire occurs, how long would you be out of production? How much damage would irreplaceable records and other materials suffer from improper extinguishing agents or methods? If the answers suggest a survey of your present fire protection then consider these facts:

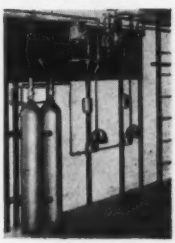
C-O-TWO smoke detecting combined with fire extinguishing is new — modern. The slightest trace of smoke is detected instantly. This new C-O-TWO protection is not dependent upon heat. It operates instantly on the detection of smoke. C-O-TWO pressure release will automatically close doors and windows—isolating a fire. Dry sub-zero carbon dioxide gas from a C-O-TWO built-in system will extinguish a fire in seconds without damage to materials or machinery.

Portable extinguishers including the famous C-O-TWO Squeez-Grip valve — wheeled units or hose reel types, afford additional protection against incipient fires. All employ carbon dioxide, the fastest non-damaging fire extinguishing agent. C-O-TWO engineers will help you plan modern fire protection.

Write for information.

C-O-TWO Detects Smoke . . . Kills Fire

Saves Lives . . . It's Fast . . . It's Modern



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AFFILIATED WITH PYRENE MANUFACTURING COMPANY

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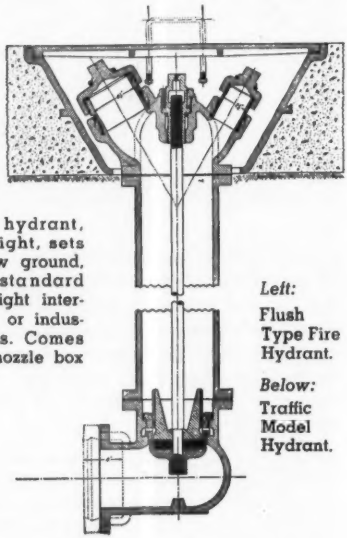
VALVES
HYDRANTS
AND PIPE LINE ACCESSORIES

M & H furnishes a complete line of AWWA Valves, iron body, bronze mounted.



Flush type fire hydrant, illustrated at right, sets completely below ground, is used where standard type hydrant might interfere with traffic or industrial operations. Comes with cast iron nozzle box and cover.

Left: Flush Type Fire Hydrant.

Below: Traffic Model Hydrant.

AWWA & UNDERWRITERS APPROVED FIRE HYDRANTS

M & H Fire Hydrants are dry top and revolving head. They are easy to lubricate. Maintenance costs are low due to simplicity of design and rugged construction. They have low friction loss and great efficiency because barrel diameter is not reduced and there are no working parts or obstruction in waterway. Special Traffic model is designed to yield at the ground line under impact. Repair is simple and easy.

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MEANS SAFE EXIT!

Von Duprin, the original self-releasing exit device, offers you the surest, safest, quickest means of exit. These devices provide positive exit at all times, even though the doors are locked against entrance from the outside.

Von Duprins are again being made of drop-forged bronze and brass, as well as the malleable iron which served so well during the war. Made in a wide variety of types for both single and double doors, Von Duprin provides the exact device to comply with your recommendation under almost any exit condition.

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VONNEGUT HARDWARE CO., INDIANAPOLIS 9, IND.

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Directional Flow Sprinklers
Open Sprinklers
Spray Sprinklers
Alarm Devices

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Alarm Valve (Wet) Systems
Dry Pipe Valve Systems
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Heat-Actuating Devices
Pre-Action Systems

Star Automatic Sprinklers and Fire Protection Devices bear approval of all Insurance Authorities having jurisdiction and various Governmental Agencies

Economy in installation cost and maintenance has dictated the consistent policy of Star Sprinkler Corporation in distributing its Fire Protection Devices through local licensed contractors who have had a lifetime of experience in the installation of automatic sprinkler systems. Operating throughout the United States, Canada and South America, Star licensees, due to their strategic locations, can render instant service. Write us for name and address of Star licensed contractor nearest your location.

STAR SPRINKLER CORP.

Westmoreland and Collins Sts. — Philadelphia, Pa.

Your plant is protected against fire; we hope your home, too, has adequate protection

During past years of intensive production when great quantities of flammable materials were used, plant management and industrial engineers re-learned the value of having Pyrene fire protection equipment throughout their establishments. Factories installed various types of additional equipment to protect new or enlarged risks and often avoided possible large fire losses. Yet it is astonishing that so many men in industry neglected to place fire protection equipment in their own homes. *7,500 persons are killed in dwelling fires annually and 350,000 dwelling fires are reported.*

The Pyrene one quart Vaporizing Liquid Extinguisher is effective and fast-working on all types of incipient fire likely to occur in the home. Strategically placed, it may prevent serious damage and loss of life in dwelling fires. Right now, the one quart Pyrene protects thousands of homes throughout America. Make sure of your own home fire protection and also keep a one quart Pyrene handy in your garage, camp, cabin and boat. Available at your hardware, department store or automotive dealer.

By the way: When did you last test the fire extinguishers in your home? Be safe . . . keep a Pyrene refill handy.

Pyrene Manufacturing Company
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Affiliated with the C-O-Two Fire Equipment Co.

FIRE TAKES ONE AMERICAN LIFE EVERY HOUR

SHIELD THEM FROM DANGER

S.O.S.
FIRE GUARD
1 quart

S-O-S Fire Guard vaporizing liquid fire extinguisher (shown above) is especially effective on electrical, gasoline, oil, and grease fires. Handy one-quart size for motor vehicle or home use. Patented Safety Phlare cylinder design assures NEW pump action at all times. Underwriters' Classification B-2, C-2.

MAKE sure your family, your employees, and your property are safe from the menace of fire.

Look for the display featuring this dramatic illustration. You will find it in leading hardware, auto accessories, marine, mill, janitor, and electrical supply, and other retail and wholesale outlets. It is your guide to dependable fire protection for car, truck, boat, plane, home, or factory.

IF IT'S GENERAL IT'S DEPENDABLE

General Detroit manufactures a complete line of portable fire extinguishers—the *right* extinguisher for every fire hazard.

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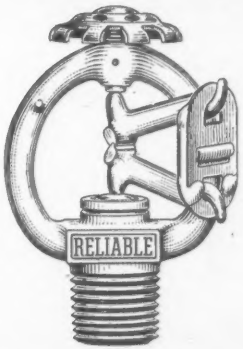
SUPERFINE

AUTOMATIC SPRINKLER DEVICES



Are excellent in design and construction — have a perfect field record — are universally approved by all Fire Insurance and Governmental Authorities — and effect maximum reductions in fire insurance premiums.

Comprise a complete line including Automatic Sprinklers, Open Sprinklers, Alarm Valves, Dry Pipe Valves, Circuit Closers, Water Motors and all other accessories required in Sprinkler Systems. Other fire protection devices and materials also furnished.

Reliable Sprinkler Equipment now protecting thousands of properties throughout the United States, Canada, and the world.

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Bronx and Locust Streets • Mount Vernon, N. Y.

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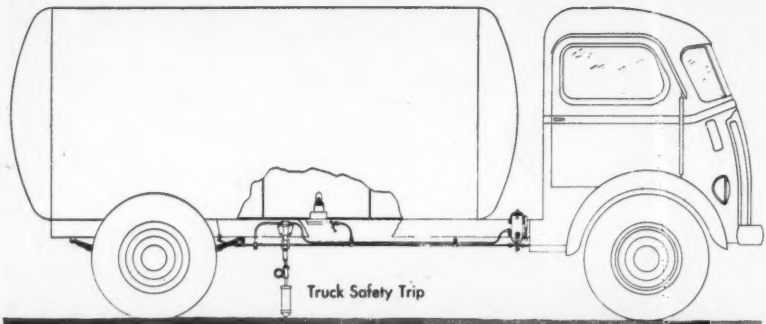

Truck Safety Trip

FOR L.P.G. HAULERS!

The transportation of Liquefied Petroleum Gases presents hazards far beyond the hauling of less volatile hydrocarbons. To meet these known requirements we have designed special hydraulic internal safety valves for the compartments of L.P.G. trucks, and special operators to actuate the safety valves. In our L.P.G. system we have gone the limit in providing maximum safety during unloading operations as indicated by the drawing of the Truck Safety Trip shown above. Any movement of the truck—forward, backward, or sideways—automatically releases the hydraulic pressure and instantly closes all valves which may be discharging. Should an accident rupture the discharge hose through truck movement—all valves would be closed before the hose ruptured. That's MAXIMUM SAFETY.

SHAND & JURS CO.
BERKELEY, CALIFORNIA

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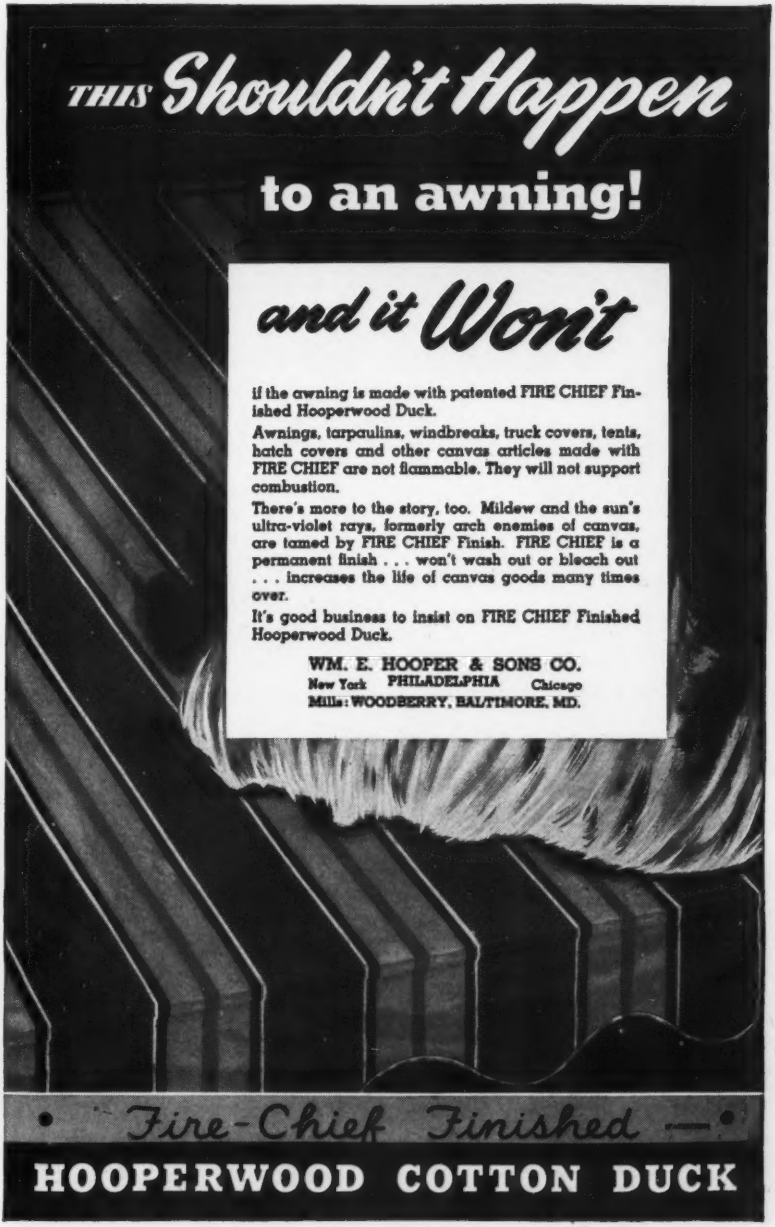
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to an awning!
and it Won't
if the awning is made with patented FIRE CHIEF Finished Hooperwood Duck.
Awnings, tarpaulins, windbreaks, truck covers, tents, hatch covers and other canvas articles made with FIRE CHIEF are not flammable. They will not support combustion.
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TO KEEP FIRE DAMAGE DOWN?

We have specialized, for many years, in the manufacture and application of equipment designed for the rapid extinguishing of fires in flammable liquids and electrical apparatus—with minimum damage by fire or by extinguishing agent.

We have, naturally, accumulated a wealth of experience in dealing effectively with these Class B and Class C fire hazards. This experience is at your disposal whenever it can be helpful to you.

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Walter Kidde & Company, Inc.
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Kidde

"IT'S BETTER TO SOAK IN BED
THE 'AUTOMATIC' WAY
THAN TO GO UP IN SMOKE
LIKE A BALE OF HAY"

But seriously—fire protection for *every* business is an essential. And the design and development of this protection is the one thing to which "Automatic" has devoted its entire business career. Let us assist in planning definite "Automatic" Sprinkler fire protection for you.

—a famous member of the "Automatic" Sprinkler Family. Provides adequate protection for quench tank, transformer, oil line and other fires of flammable liquid origin.

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"Automatic" Sprinkler manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories.

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FIRE DEPARTMENT

IN YOUR OWN PLANT

INDUSTRIAL SPRINKLER SYSTEMS

Viking Sprinkler Systems go into action with the speed of a Fire Department in your own plant. In peace and war Viking Sprinkler Systems are protecting industrial plants across the nation against the universal enemy of production . . . . FIRE. There is a Viking dealer near you to give you all the facts.

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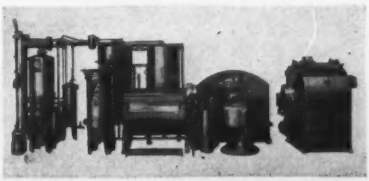
HASTINGS, MICHIGAN

. . . TO TRY TO GET 140-F BENEFITS FROM HIGH-FLASH SOLVENT ALONE!

Fire prevention authorities and dry-cleaning experts agree; it's not high flash solvent alone—nor Underwriters Laboratories approved machinery alone—but the combination of the two—that produces complete drycleaning safety. Due to wartime shortages, some attempts have been made to use high-flash petroleum solvent in equipment lacking approved safety features. Such makeshifts are to be deplored.

Drycleaners using Hoffman 140-F drycleaning systems are able to continue their legitimate operations—using 140-F Class III machinery with listed high-flash solvents.



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105 Fourth Ave., New York 3, N.Y.
DRY CLEANING, LAUNDRY & GARMENT PRESSING EQUIPMENT

700 FOR 1 . . .

. . . WITHOUT *Water Damage!*

Think of it! One FIRETOX unit can be installed in less than ONE cubic foot of space, yet it protects 700 cubic feet!! . . . FIRETOX works automatically. . . . Safeguards property with silent efficiency. . . . FIRETOX is your watchman in such danger spots as—Gas and Diesel generator rooms; Boiler, storage, trash, paper rooms, record vaults. . . . Attics, basements, garages. . . . Public buildings, banks, libraries, schools. . . . Storage places of flammable liquids, such as gasoline, paint, lacquer, naphtha, alcohol.

No water damage from FIRETOX! Why? . . . Because carbon tetrachloride is the extinguishing medium. Ammonia is the motive power. It expels the carbon "tet" under pressure and effectively prevents the presence of chlorine, hydrogen chloride and phosgene. FIRETOX is installed on the ceiling, starting to work at approximately 165°, atomizing the carbon "tet" into the air, where it is transformed to a heavy gas vapor—settling like a blanket over the fire!

NO WATER DAMAGE!

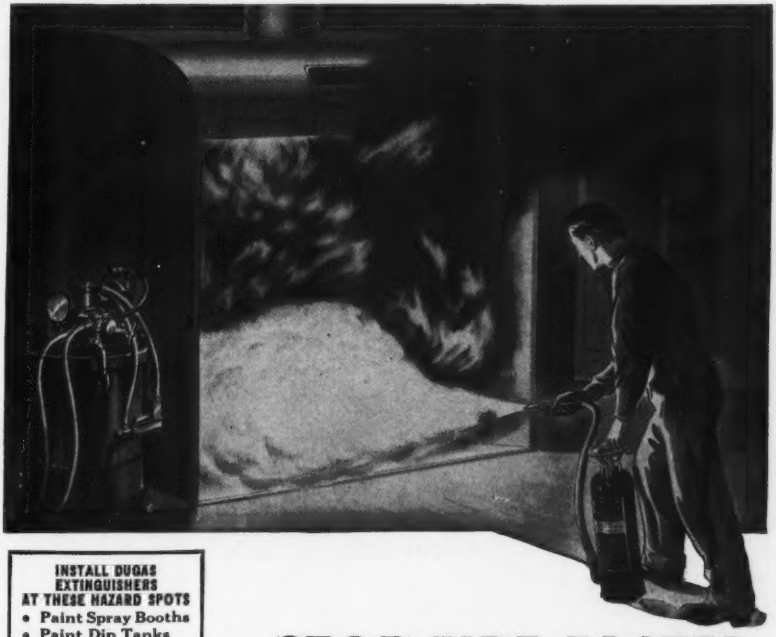
FM

FIRETOX SPECIALISTS ... are available for consultation throughout the country. Write our Main Office for "Specialist" nearest you.

The approval identification mark of the Factory Mutual Laboratories which appears on the label of each device.

FIRETOX SYSTEM, INC.

MAIN OFFICE: 998 FARMINGTON AVE., WEST HARTFORD, CONN.



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- Paint Spray Booths
- Paint Dip Tanks
- Oil Quench Tanks
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- Fuel Oil and Gas Installations
- Transformers and Other Electrical Equipment
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STOP FIRE *FASTER*

WITH

AN ANSUL PRODUCT
DuGas
THE MASTER OF FLAME

DRY CHEMICAL

DUGAS 15-T
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● Upon striking fire, DUGAS Dry Chemical instantaneously releases 1,100 times its volume in flame-smothering gas that chokes off fire in seconds. The swift, fire-stopping power of DUGAS Dry Chemical is unaffected by wind or draft. It is undiluted by passage through the air. The gas is released only in the immediate flame area.

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Write today for further information including authoritative, impartial data showing characteristics of all types of approved fire extinguishers. The Ansul technical staff of fire protection engineers is ready to serve you.

Listed and approved by Underwriters' Laboratories and Factory Mutual Laboratories

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FIRE EXTINGUISHER DIVISION, MARINETTE, WISCONSIN

A CENTRAL SPRINKLER SYSTEM

FOR EVERY FIRE PROTECTION SERVICE

SIMPLE IN CONSTRUCTION

DEPENDABLE IN OPERATION

CENTRAL Standard Wet and Dry Pipe Systems

CENTRAL Thermostatically Operated Rate-of-Rise Open and Closed Head Deluge Systems

CENTRAL Fog Nozzle Manual and Automatic Systems

Self Liquidating as to Cost Through Reductions in Insurance Premiums

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You will *know* that your plant is under vigilant supervision when your proof is recorded by time tested and proven

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Known for more than Sixty Years for Reliability-Accuracy-Durability

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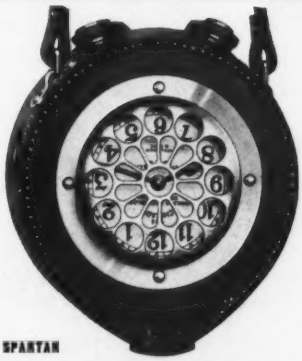

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Four Models: One to fit every need for providing complete plant protection

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Fire Protection at BRETTON WOODS

The lives and property of the men who drew up the Bretton Woods agreements in July, 1944, were protected from fire by an automatic sprinkler system and the 100,000-gal. elevated water tank shown above. Thus the 18 billion bank to help rebuild war-torn countries and stabilize world currencies which "opened for business" last December got its start under the "watchful eye" of a gravity water supply.

CHICAGO BRIDGE & IRON COMPANY

CLEVELAND	CHICAGO	BIRMINGHAM	NEW YORK
WASHINGTON	DETROIT	ATLANTA	PHILADELPHIA
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FOAM
THE MODERN PROTECTION

NATIONAL FOAM mechanical or chemical, fully protects all risks involving flammable liquids by quickly putting out, *and keeping out* fire

NATIONAL FOAM SYSTEM, INC., has what it takes to quickly put out, and keep out, fires threatening American commerce on land or at sea. Mechanical (Aer-O-Foam) or chemical foam, rapidly applied, easily transported, produced in volume, wastes no time smothering fire.

Generations of fire-fighting "know-how" stand behind National Foam protection. Original developer and manufacturer of Aer-o-foam, National has long produced both mechanical and chemical foam. Both form thick, tough, enduring foam blankets. Fire fighters are not adversely affected in smothering fire with foam—that refuses to blow away.

National Foam adheres to upright surfaces as well as flowing freely over level areas to block off fires and gases, thus preventing flashbacks. Blanketing threatened flammable liquids, buildings or equipment, National Foam isolates fire for quick extinction.

There's no substitute for fire-fighting experience. National Foams and equipment have proven their worth in peace and war.

NATIONAL FOAM SYSTEM, INC.

SPECIALIZING IN FOAM FIRE PROTECTION

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EMBODY UNIQUE FEATURES OF ADVANCE DESIGN

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All current models — the product of continuous research, vigorous development and long experience — more responsive, flexible and enduring, provide long life and minimum maintenance and are approved by all Government and Insurance Authorities.

OUR GOAL
With added speed and certainty, to
AUTOMATICALLY
discover, alarm, and extinguish fires.

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Automatic Sprinkler Co.
2035 WASHINGTON AVENUE
Philadelphia 46, Pa.
SALES OFFICES IN PRINCIPAL CITIES

Leading Safety Engineers and Insurance Inspectors Choose Eriez For Hazardous Locations

Typical installation over belt Conveyor.

Eriez Magnet suspended over spiked apron of feeders, etc.

THE wide preference of Eriez Non-Electric Permanent Magnets is based on the following advantages:

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2. **Completely Non-Electric – cannot Spark.**
3. **Lowest Initial Cost.**
4. **No Operating Cost. No Repair Cost.**
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6. **Easiest To Install.**
7. **Unconditional 10-Year Free Service Guarantee.**
8. **Made Any Size to Fit Your Requirements.**
9. **MOST PROTECTION PER DOLLAR.**

APPROVED BY MILL MUTUALS

Write today for Bulletin 101 (Milling), 102 (Industrial), 104 (Textile)

When It's Magnetic Protection . . . . . See Eriez First

ERIEZ MANUFACTURING COMPANY

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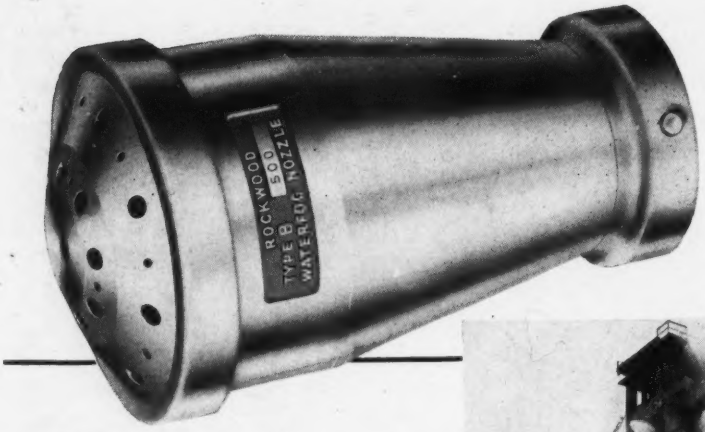


New High Capacity

WaterFOG Nozzle Speeds Control of Class "A" Fires

Now fire fighters are successfully using WaterFOG to attack Class "A" fires from any angle . . . in buildings, lumber yards, basement areas, etc.

Rockwood's new 500 GPM Type B WaterFOG Nozzle, designed for use on deluge guns, ladder pipes, etc., supplements the Type SG-40 WaterFOG Nozzle for regular hose lines.

KNOCKS DOWN CLASS "A" FIRES FASTER

Fire departments using WaterFOG to extinguish Class "A" fires report that its fog pattern lowers temperature faster than straight stream . . . protects men and equipment . . . permits closer approach . . . reduces water requirements . . . lessens damage.

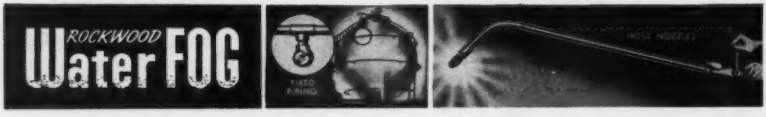
For complete data on the new Rockwood 500 GPM Type B WaterFOG Nozzle, write for Bulletin 500.

Rockwood 500 GPM Type B in action at the New Haven Fire Department's Technical Training Grounds.

ROCKWOOD SPRINKLER COMPANY
56 Harlow Street, Worcester 5, Mass.

Specialists in Fire Protection Engineering, Equipment and Installation since 1907.

Water Engineered by Rockwood Cools, Confines, Smothers Class "A" and Oil Fires



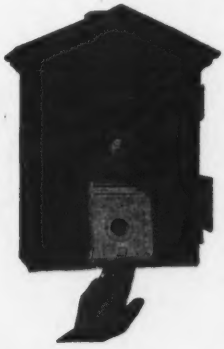
Eliminate

Delayed Alarms

Reduce

Fire Losses

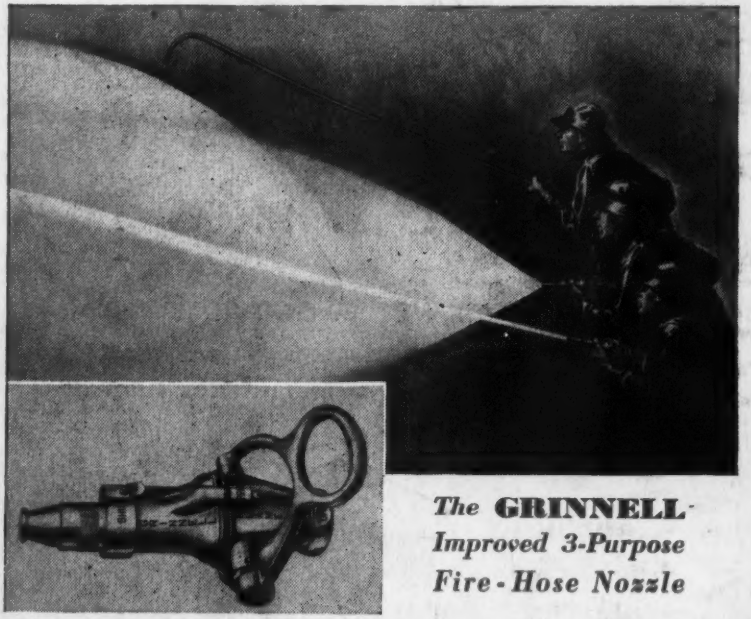
WHEN FIRE OCCURS
Call the Fire Department. Delay creates unnecessary fire waste and life hazard



Fire Alarm Boxes
Save Time and Protect Life, Property and Income
Write for details

THE GAMEWELL COMPANY
Newton Upper Falls 64 - - Massachusetts

FLAMEBUSTER



The **GRINNELL** *Improved 3-Purpose Fire-Hose Nozzle*

Grinnell offers FlameBuster, a portable fire-hose nozzle, as an effective supplement to its complete range of fixed systems of fire protection. It permits quick selection of water in the form best suited for putting out fires in both Class A materials and oils.

The Low Velocity spray, projected by a unique Grinnell tip on a 4′ to 10′ applicator, puts out fires, with minimum water consumption, in the lighter flammable oils.

The High Velocity spray extinguishes fires in heavier oils by forming with the oil a fire-extinguishing emulsion.

The Solid Stream is for mopping-up operations on wood or similar materials burning beyond the range of spray.

Descriptive folder is available without obligation. Write to Grinnell Company, Inc., Providence 1, R. I., or Branch Offices in principal cities.

GRINNELL

AUTOMATIC SPRINKLER FIRE PROTECTION